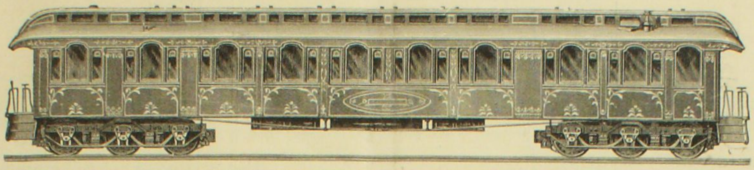
National Car and Locomotive Builder.



VOLUME XVIII. }
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Miscellaneous Items.

WE learn from Mr. G. W. Bentley, general manager of the Jacksonville, Tampa & West Key Railway, that they are changing from three feet to standard the gauge of one of their branches.

MR. JOHN W. CLOUD, so well known as engineer of tests and lately as mechanical engineer of the Pennsylvania Railroad, is appointed superintendent of motive power of the New York, Lake Erie & Western Railroad. Mr. Cloud is one of the ablest men of the Pennsylvania school.

ON some of the passenger cars belonging to the Chicago & Northwestern Railway there is a brake-beam in use made from a piece of 2-inch pipe, which is reinforced by an iron truss-rod ⅞-inch thick. The beam is light and ought to be cheap. It is said to work satisfactorily.

THE narrow gauge railroad mileage is being gradually reduced. The Illinois Central Railroad Company have obtained possession of the Havana, Rantoul & Eastern narrow gauge railroad, which extends from Le Roy, Ill., to West Lebanon, Ind., and intend changing the track and equipment to the standard gauge.

MR. J. W. FERRIS, General Manager Toledo & Ohio Central Railway, writes us that during last year they improved the property by laying five miles of 60-pound steel rails. They contracted for 1,400 new twenty-ton cars which they are now receiving; they built one locomotive in their own shop and purchased eleven new ones from contract shops.

THE American Brake Co., St. Louis, are making extensive improvements in their plant, consisting of a new machine shop and large additions in new tools and machinery. The growth of the company's business is such as to render an increase of facilities indispensable, and even further enlargements are contemplated as soon as the plans for them are matured.

SEVERAL express refrigerator cars have been lately completed for the Michigan Central by the Michigan Car Works, at Detroit. The cars are fitted up to run on passenger trains, and are constructed on the Hutchins principle. The essential features are that the inner and outer sides of the car are completely isolated from one another by a tight packing of clean woolen rags.

THE Westinghouse Air Brake Company have recently received from the Northern Pacific orders for 100 sets of equipment for locomotives; from the Union Pacific 500 sets of freight car equipments; from a Chilian railroad orders for 100 sets of brakes for passenger cars; from the New York, Lake Erie & Western, orders for 100 sets for freight cars and about 200 sets in odd orders. The shops at Allegheny are very busy.

MR. L. T. MYERS, superintendent of transportation of the Seaboard & Roanoke Railroad, writes us as follows about improvements effected last year: This company has an old trestle with an iron bridge; built a new brick passenger station at Suffolk and a roundhouse with capacity for 23 locomotives at Portsmouth. Rebuilt 13 flat cars and 10 box cars and purchased 2 first-class passenger coaches. Put extension fronts on 18 locomotives.

M. M. BURKE, general superintendent Mississippi & Tennessee Railroad, writes us: During the last year we have laid almost 25 miles of steel rails and reduced some of our heaviest grades from 46 feet to a maximum of 35 feet per mile. We have built several brick culverts, etc. In our shops we have built one coach and one baggage car, and rebuilt about 25 box cars. We have added to our equipment by purchase 2 first-class coaches and 50 box cars.

FROM Mr. B. R. Swoope, superintendent of the South Florida Railroad, we learn that during the last year they have expended about $24,000 in improvements on buildings. He also says: We have changed the gauge of our main line from Sanford to Tampa from 3 feet to 4 feet 9 inches. To equip this standard gauge road, we purchased nine new locomotives, and have six narrow gauge locomotives which we propose to change to standard gauge.

MR. ROSS KELLS, who was lately appointed assistant superintendent of motive power of the New York, Lake Erie & Western Railroad, with headquarters at Cleveland, is a well-known master mechanic. For some years he has been out of railroad work, having held the position of superintendent of the Paige Wheel Works at Cleveland. Previously he was superintendent of motive power of the New York & New England Railroad, having gone there from the New York, Pennsylvania & Ohio Railroad.

MR. C. L. WILLIAMS, superintendent of the Ohio River R. R., writes us that this road has extended its line during the past year to Point Pleasant, W. Va., a distance of 78 miles. Have built a machine shop 40 × 100 ft., a car shop 40 × 90 ft., and a blacksmith shop 32 × 80 ft., equipped with machinery; also a five-stall roundhouse at Parkersburg and one of four stalls at Point Pleasant; have put in two track scales and improved side track facilities, and added 6 Brooks 8-wheel locomotives, 2 baggage cars, 8 coaches, 150 box, 100 coal and 50 stock cars to the equipment.

MR. W. H. PETTIBONE, general superintendent of the Toledo, St. Louis & Kansas City Railroad, writes that they are preparing their permanent way for standard gauge, and expect to change this year. They expect also to build several new depots this season, prominent among them being one at Frankfort, of stone, to cost $6,000. They have confined themselves for some time past in the shops of the road to doing only such repairs as would keep the rolling stock in running order, as they expect to purchase a full outfit of new rolling stock to be ready for the change of gauge.

IN connection with the discussions recently carried on in the Western Railway Club respecting the effect of light and heavy driving wheel centers and tires, it is interesting to learn the experience of the Pennsylvania Railroad Company with light and heavy wheel centers. Mr. Ely, writing on the subject to the Secretary of the Western Railway Club, says: "We equipped, several years ago, two locomotives with wrought iron driving wheel centers, which seem to be doing well. They are, however, more expensive than cast iron centers, which answer our purpose satisfactorily."

THE Ohio Falls Car Co. have built six suburban passenger cars for the Wisconsin Central line. The interiors are finished in oak, a large proportion of English oak being used. The painting of the ceiling is a work of art, and was designed by Col. Sprague, of the car company. It is made after the style of the old Grecian home, with the light apparently coming through the roof and vines trailing over the glass through which the light comes. These cars have 14 lamps, six of them being side lamps, Wakefield rattan seats, and are heated with Baker heaters. It is the intention of the company to finish all their passenger coaches with English oak.

THE *Northwestern Lumberman* says that the comparative activity which prevails in the Chicago lumber yards must be mostly accounted for by the continued good demand for car factory stuff, which appears to be insatiable and more or less affects all the yards favorably, because all have some stock that can be appropriated for car building purposes. Norway, 2×6, 2×8 and 2×10, 18 and 20, is getting scarce in many of the yards. The same paper also says that the car works of Wells, French & Co., of that city, are turning out twenty cars a day, each car requiring 5,000 feet of lumber of all sorts. Considering that all the car shops of the country are busy, it is evident that the aggregate of soft and hard lumber that is being consumed in car building is immense.

MR. T. M. R. TALCOTT, general manager Mobile & Ohio Railroad, writes us: We have added to our equipment 16 locomotives and 500 freight cars during the last few months, for the purpose of equipping the St. Louis & Cairo Railroad, now operated by us as a standard gauge. We have changed six narrow gauge engines of the consolidation type to standard. The Cairo & St. Louis has been rebuilt from Cairo to East St. Louis, and laid throughout with new steel rails. New iron bridges of a capacity to carry the heaviest equipment have been built across the Okaw and Big Muddy rivers. New iron bridges are in progress of erection on the M. & O. railroad proper, at Limestone, Tibbee, Sucarnochee, South Obian, North and South Forked Deer rivers, and also nine plate girders from thirty to sixty feet span across minor streams.

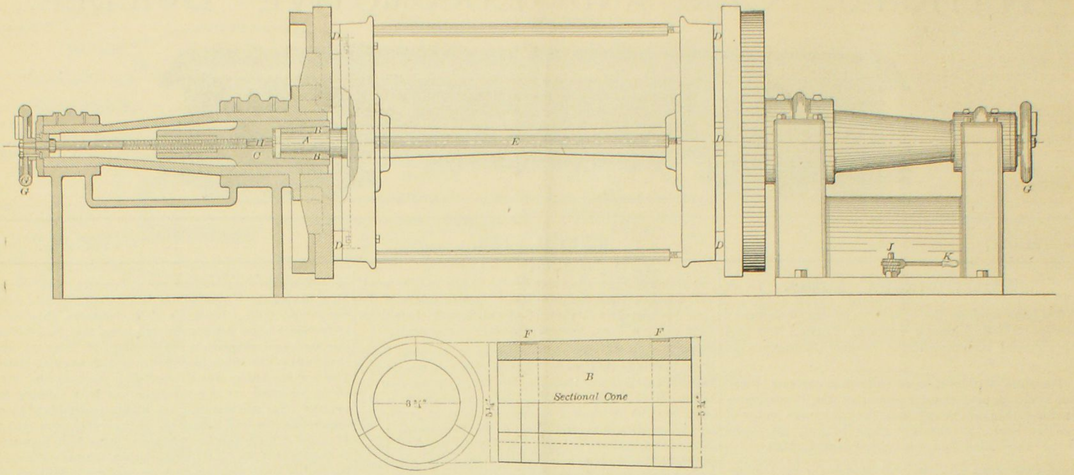
AMONG the improvements effected on the Minnesota & Northwestern Railroad lately has been the building of new repair shops and complete mechanical headquarters at South Park, near St. Paul. The shops were badly needed, repairs for passenger car and motive power equipment having been carried on in a roundhouse and some temporary sheds. From Mr. C. E. Densmore, chief clerk of the mechanical department, we learn that they moved into the new headquarters in the middle of February, and that already the whole place is in smooth working order. The new machinery was all started up together, and went on as smoothly as if everything had been running for months. The performance was highly creditable to those responsible for the fitting up of the power connections. The road mileage and the equipment have been increased so rapidly that Mr. T. W. Heintzelman, master mechanic, has had a most difficult task to perform in keeping the rolling stock running with the few conveniences provided to house and care for it.

MR. W. H. FISHER, president and general superintendent of the St. Paul & Duluth Railroad, writes us: The following improvements have been made on this road during 1886. Reduced grades from Hinckley to Barnum, 37 miles. Maximum grades were 100 feet, reduced to 26 feet to the mile. Built eight miles of new side track. The new buildings erected were: Water tank, at Duluth; engine house of five stalls addition at Claymont; sand house at U. P. Junction; two flour houses at Duluth; flour dock at Duluth; coal dock at Duluth; depots at Centerville and Gladstone; coal sheds at U. P. Junction, Claymont, Hinckley and Rush City; turn-table at U. P. Junction; station at Sandstone Junction, and three stalls addition to Hinckley engine house. The additions to equipment were 500 box cars, 6 locomotives, 2 sleeping cars and 4 caboose cars. All these were made by contract. The Duluth Short Line Co. are now building road from Thomson to Omota, 13 miles; will also build from Omota to West Superior, Wis., branch line 5 miles long. Both these lines when completed will be operated by the St. Paul & Duluth Railroad.

THE Chicago, Burlington & Quincy Railroad Company have been very fortunate in securing the services of particularly bright young engineers as assistants in the department of tests, and the higher officers show a commendable disposition to encourage competence, zeal and industry by rewarding them with promotion to higher positions. We mentioned a few months ago the promotion of Mr. E. M. Herr to be engineer of tests, vice Mr. P. Wallis, promoted to be master mechanic at Beardstown, and we are now pleased to announce that Mr. Herr has again been promoted to acting superintendent of telegraphs. Mr. Herr was a telegraph operator before he went to learn engineering, and he devoted much ingenious labor to developing the quadruplexing system of telegraphy. While in the testing department he was sent East several times to investigate matters connected with telegraphy, and it is very fitting that he should be selected for promotion in that department. He will be succeeded in the department of tests by Mr. F. W. Sargeant, another technical school graduate who has been engaged for some time working up a rail record in which he has displayed a high order of ability.

Mr. Theodore West, a well-known English engineer, lately read a long paper at an engineering meeting, on the American locomotives. Toward the conclusion he says:

"The Americans being much better acquainted with the conditions of a new country, and more pliable and ready-witted in meeting them than most Englishmen, we are not surprised that every now and then orders for engines for our colonial railways are sent to American makers in preference to English, or that the Fairlie engine, which is remarkably fitted to meet their conditions, should be selected among English types. It is in careful and patient consideration of all the circumstances of the case that the English engineer is likely to meet our Transatlantic rivals fairly in the market, and to recover diminishing trade, rather than in jealous and misplaced comparisons of superficial finish or express speeds, just as his rivals must have something better than the mere boast that he or his country make the best locomotives in the world. Having traveled pretty extensively in the States and Canada, we admire exceedingly and respect the Americans for their enterprise, skill, and versatility of inventive faculty as much as we have reason to feel grateful for the courtesy and hospitality shown to us. A nation that has constructed 137,000 miles of railroad over all sorts of country, full of engineering difficulties, that possesses about 20,000 locomotives, and up to 1875 had taken out some 4,000 patents for inventions in railway machinery, may well be credited with ability equal to our own in these matters, however different may be its ways and the superficial appearance of some of its appliances."



LATHE FOR STEEL-TIRED CAR AND LOCOMOTIVE WHEELS.

The accompanying illustration shows the most effective and simple method now in use for securing steel tired car and locomotive wheels in lathes for turning tires. The axle is supported on its journals, and by this method the wheels are held so rigid that the heaviest possible cuts are taken, limited only by the power of the lathe and the strength of the tool. This method is so simple that a brief description only is necessary.

By referring to the drawing which illustrates the invention as applied to one form of wheel lathe, the center spindle C is bored out to receive an elastic annular wedge shaped sleeve B, which receives and supports the axle journals. Before placing the wheels in the lathe the sleeves B are slipped on the journals, the center spindle being bored tapering, readily receives the sleeves and immediately centers the axle, one of the lathe heads being movable and quickly operated by a ratchet and lever. When the movable head is secured to the lathe bed, the center spindles are forced upon the sleeves by the hand-wheel G, holding the axle perfectly rigid, practically making it a part of the lathe spindle. An idea of the support imparted to the axle may be had from the fact that were it not for the torsional strain on the axle the tires could be turned without any other provision for driving the wheels. This is a feature peculiar to this system of supporting the axles.

This method also enables the wheels to be brought in close contact with the face plates, admitting of a simple and effective driving appliance.

A lathe now in use at the Como shops of the Northern Pacific R. R., at St. Paul, to which this improvement is applied, is now doing the work that formerly employed three ordinary wheel lathes. In every day practice, the time consumed in placing a pair of wheels in this lathe ready for cut is eight minutes.

This arrangement for turning steel tired wheels is applicable to ordinary driving wheel lathes, as shown in attached drawing, and makes an effective lathe for shops where the amount of work would not necessitate a special tool, and can be applied at small cost.

The lathe was invented jointly by Mr. H. J. Small, master mechanic at Brainerd, Minn., and his general foreman, Mr. McNaughton.

Car Heating.

The following letter to one of the editors of this paper is from a remarkably clear-headed master mechanic, and the subject being of great interest at present, we give our readers the benefit of Mr. Player's views:

"Since I saw you I have been thinking somewhat over the problems of car heating, and to me it seems that the surest, safest, and, after first cost, most economical way to accomplish the purpose would be to have a car built and equipped with boiler of sufficient capacity to furnish necessary steam for heating the whole train and also run a dynamo to furnish electric light, such an one as is used on the ocean boats. The space necessary for such a plant would not be excessive, counting in space for coal. It certainly would be very cleanly, and a train running so equipped might be fairly considered luxurious. I know there would be objections where one car is set out at some way side station, but for full trains at terminals there can be none. The train could be warmed and lighted perfectly before leaving, and kept in like condition during the whole trip, or, even, as some folks are afraid of, stuck in a snow-drift.

"A car so arranged I think would not be any more dangerous than the dining car with its range, etc. For water supply the tank might be placed under the car of any required depth needed for water, and the probability would be in case of derailment or overturning, there would be some water there to drown the fire. I am not sure but that with the present space in the dining car, the boiler with dynamo and the range for dining car could be placed in one end and take fuel and water from the same source, and by so doing avoid the extra car on lines where dining cars are running. I send you these notes so that, should you consider them of any value, you can use them for the benefit of all those interested in the matter of safety to trains as relating to light and heat.

"I think the only objection to the dining car arrangement might be excessive weight on one truck, and that is a serious one, but could be overcome in a measure by placing water tank at one end of car and boiler, etc., at the other." JOHN PLAYER.

MARSHALLTOWN, Ia., Feb. 19.

Fraudulent Attempts to Obtain Passes.

While calling at sundry railroad offices during a recent journey, our attention was directed to three several attempts to obtain annual passes by parties connected with a rafting company in New Hampshire, under the pretense that a railroad company was the applicant. One of these applications reads as follows:

NORTHERN R. R. & S. Co.
OFFICE GENERAL SUPERINTENDENT,
NASHUA, N. H., Jan. 18, 1887.

C. J. Ives, President & General Superintendent, B., C. R. & N. R. R.

DEAR SIR: I respectfully request annual passes for the year 1887 for the following persons whose duties will require them to travel over your lines in the interests of this company.

F. DAVIS, Trav. Agt.

I shall be pleased to respond to similar requests from you.

Respectfully, A. W. MONTY, Gen. Supt.

The "R. R." of this company stands for "river rafting." The company owns no railroad, and its pretended readiness to "respond to similar requests" is a barefaced fraud, and the party making such pretense should be sent to the penitentiary.

Joseph Whitworth.

Editors National Car and Locomotive Builder:

The greatest of modern engineers passed away to his rest on January the 22d at Monte Carlo.

In due time the life and works of this great man will be no doubt published, but it appears to me that a few words about him and some of his works, from one in this country who knew him, and was in some way an early helper in advancing his inventions, can not fail to be of interest to your readers.

Joseph Whitworth was one of a group of extraordinary men, of whom were William Fai bairn, the father of experimental mechanics; Robert Napier, the father of transatlantic navigation; John Penn, the famous marine engine builder; Richard Roberts, of spinning machinery fame; James Kennedy, who gave the locomotive the car frame and the crank axle with its inside cylinders, and James Nasmyth, whose steam hammer revolutionized the forges of the world.

Joseph Whitworth, the feeblest in bodily health of all these his contemporaries, has survived them all, save and except Mr. Nasmyth, who retired from active life when comparatively a young man and has been but little known in the mechanical world since, though in the scientific world he has done a great deal in connection with his telescopic works on the sun and his beautiful book on the moon.

The last time I met Mr. Nasmyth was at a celebrated trial in the Guild Hall, London. A tire on the Eastern Counties Railway broke and killed some people, and heavy damages being demanded, the case came before the courts, Cockburn being the judge and Bovil and Edwin James the opposing counsel. I remember Cockburn complimenting Mr. Nasmyth on the very clear evidence he had given, and I had some talk with him about the old days at Patricroft, where I was for a short time a workman.

Within these few years the Autobiography he published gave to the world the trials and the difficulties of his life and his successes, but to those who knew Patricroft in the old days it was doubly precious as a reminiscence of old times.

With the exception of Mr. Roberts I knew personally all the others: with Mr. Kennedy's firm in Liverpool as a workman, and with Messrs. Fairbairn, Napier, Penn, Kennedy and Whitworth as a member of the Council of the Institution of Mechanical Engineers. Mr. Fairbairn was the President when I became a member of the Council, and I have the most pleasant recollections of him.

Physically he was a very fine looking man, tall, handsome, with bright blue eyes, and a clear, ruddy complexion. He was the picture of a man who had come from a good, healthy stock, and who, while he had been a hard worker, had taken care of his health in his youth and manhood, and carried in his maturer years a vigor and a vitality which showed itself in his every word and action.

Mr. Fairbairn was not much of a speaker, indeed the only really eloquent member we had was Mr. Scott Russell, who built the Great Eastern, but if not eloquent Mr. Fairbairn, out of his immense experience, was a most capable President, and gave a great deal of valuable time to build up and strengthen the institution. He never forgot his Scotch accent, he never kept anything back which he knew, but all his stores of experiments, as well as experience, were freely given to the members as occasion required.

At that time our President was the greatest authority on every subject connected with the manufacture of iron, in beams, and columns, in ships, in boilers, and his most famous design, the bridge over the Menai Straits, was just completed. It was something to sit alongside such a man, for, intellectually, he was a giant, but withal as modest as a maiden.

As a railway man I met him on business many times after he had retired from the presidency of the Institution. One time, I shall never forget, we stood round a dark hole in the floor of Westminster Abbey, to lay down the body of one who had been his dearest friend and associate, but whom a foolish quarrel had separated; and as I looked up at his kindly, sorrowing face, and then on the coffin, I felt what a cruel thing it was that neither of them had friends to bring about a reconciliation between William Fairbairn and Robert Stephenson.

Joseph Whitworth, who succeeded William Fairbairn as President of the Institution, and now deceased, was, as long as I had known him, a man of delicate frame. He was a man of medium height, with a weak and shaky voice, which he used as little as possible. He was no speaker, had not a scrap of poetry or imagination in his nature. When he got up to speak you felt you would not get much from him, and he rarely disappointed you; but when he prepared an opening address, or when he prepared a paper, you were never disappointed. Like Fairbairn, Whitworth began life as a workman, and he told me that he had got his best knowledge to do good work at Maudsley's, in London, and not only so, but had worked out his idea of how to make a plain surface perfectly true and correct while he was there.

Born in Lancashire, Mr. Whitworth established himself in Manchester as a tool maker, and at once put in practice the principles of perfect workmanship he had invented as a workman. No one could have begun business at such

an opportune time; the railway demands, the steamship demands for tools of all kinds came pouring in, and the difficulty with railway men in those days was where to get tools quickly. Had Mr. Whitworth done nothing else than to teach the world how to make a plain surface, that alone would have given him an undying reputation, but this was only a step to his further inventions and improvements, having perfected what Euclid and the old mathematicians had dreamt about; his next movement was the first real practical step toward duplication, viz., the entire uniformity of screw threads through the world. Only those who are old enough to remember the variety of sizes and pitches of screws before the Whitworth standard screws came out can imagine the trouble and expense the old system was. Every manufacturer had his own pitch and diameter, and the quantity of stock required, and even with that the confusion and delay were enormous.

Mr. Whitworth's next great work was his invention of a system fine measurement. Up to this time, very fine measurements were unknown in the workshop; it was only among philosophical instrument makers and watch makers that very fine dimensions were used. In the ordinary work-shops, such as Bury's in Liverpool, Nasmyth's Patricroft or the locomotive works at Crewe, the workmen used their own foot rules, and used the term of a bare $\frac{1}{64}$ or a full $\frac{1}{32}$. No doubt there were some good shop foremen who had gauges of their own, but there were no well known standards from which all could work and could test and verify their work.

At the great exhibition of 1851, Mr. Whitworth sent his measuring machine, which he showed could measure the millionth part of an inch, but it was looked upon as a toy, and nothing came out of it for many years, until he read a paper on the subject at the Institution of Mechanical Engineers, and exhibited a number of male and female gauges, made to the dimensions of one thousand part of an inch, and recommended that mechanical engineers should adopt the inch as their standard of measurement, and divide it into a thousand parts. Against this standard the greatest opponent was the ever to be lamented C. W. Siemens, who desired that the French standards should be adopted. The consequence was a series of discussions on paper, read by Mr. Whitworth and myself on this subject, and here I may say I was early brought into the discussion and settlement of this question through my having been the first to adopt Mr. Whitworth's system, in the Works of the Midland Railway Co., at Derby. The great difficulty of making a measuring machine on the Whitworth system is to make a screw which will have exactly ten threads to the inch, and how I got over this I must leave those who are interested in the subject to study up in the proceedings of the Institution of the Civil and Mechanical Engineers, and especially in the former, in a paper on Duplicate Machines and Engines.

By my machine, which was 120 inches long, every part of a locomotive engine could be duplicated, and it was possible to work as fine as to the $\frac{1}{5000}$ part of an inch with it. Since then the firm of Joseph Whitworth & Co. have sold large numbers of measuring machines, and there are few manufactories of any consequence which have not a measuring machine.

Mr. Whitworth had now completed his three great improvements in mechanical science.

1st. His method of obtaining a true plane surface.

2d. His uniform system of screw threads.

3d. His system of fine measurement.

All these lie at the basis of perfect workmanship, and without them economy of workmanship can not be obtained or maintained; but with them repetition, duplication, becomes a thing easy of accomplishment.

The next great work which Mr. Whitworth undertook seemed to be something entirely out of his line. The English government requested him to undertake a series of experiments on rifles, and this he consented to do (though up to that time he had, I believe, never fired a gun) on condition that the government would erect for him a rifle range within his own grounds. This range, which was all roofed over, was for many years the scene of thousands of experiments in gunnery.

Brown Bess, the English army infantry gun, with which the whole of Wellington's victories were gained, was a most inefficient weapon. It was a muzzle-loader, with a round leaden ball, and it was calculated that in efficiency it required as much lead as the weight of a man for every man it killed in battle.

The English Government, before the Crimean war, had sent out some engineers to examine into the mode of manufacturing rifles in the United States, and they recommended the adoption of the American system. A large number of machines were ordered from America, and a rifle, called the Enfield rifle, was used during the Crimean war. This rifle had many defects, but it was an immense improvement on Brown Bess, and inspired the War Office to desire something better, and very happily they selected the most suitable man they could have found in the world for this purpose, Joseph Whitworth.

Mr. Whitworth began his work by making a perfect mechanical rest from which to fire the rifles, and between the rest and the target he fixed a number of paper screens so that the course of the ball might be carefully traced. He was thus able to trace the exact course of the ball, the trajectory it made, and its behavior from the muzzle to the target.

He found the bullet did not proceed in a straight spinning course to its destination by the hole it cut in the screens; it had tumbled over and over in its path to the target.

The natural conclusion for such an erratic course was that the bullet was too short, and a smaller bore gun, with a longer bullet, showed this to be the case.

Mr. Whitworth's experiments proved that, with the limited amount of powder specified to be burnt, a bullet with a very small diameter and a great length, and with a very quick twist, gave the lowest trajectory and had the greatest penetrating power. Mr. Whitworth now presented his rifle and his experiments to the government; but the War Department did not accept his rifle for use in the army.

As I remember, their objections to the rifle were as follows:

1. The Whitworth rifle barrel was to be of solid steel, and it was of course to be bored out, which the Government said made it too expensive. The Enfield barrel was made from an iron bar, bent round a mandrel, then welded and then rolled out hollow, after which it was bored out and then came the operation of straightening it; this was done by the eye, and against this rude system Mr. Whitworth protested.

2. The form of the bore in the new barrel, a six-sided figure with the rounded corners, was too difficult and too expensive to make.

3. The twist was too quick.

4. It was difficult to load quickly (no breech-loaders in those days).

5. I think there was some difficulty about the test of exposure to the weather which all new rifles have to be put to.

Mr. Whitworth's new rifle achieved a great victory at Wimbledon. Fixed on a rest, the Queen fired the first shot, at 400 yards, at the meeting, and made a bull's eye.

As the War Department refused to accept the rifle, and Mr. Whitworth refused to modify it, he now turned his attention to the consideration of the same principles discovered in his experiments on rifles to the heavier work of artillery.

To show the thorough manner in which Mr. Whitworth went to the bottom of every thing he touched, I must now briefly describe how he became a steel manufacturer. Mr. Whitworth was not satisfied with settling the mechanical principles on which rifles should be made, but what should be the best material of which the barrel, the most important part, should be formed. Hence an immense number of experiments on steel, and these conducted in a very novel way all his own.

A short cylinder of steel, bored and turned to gauge, had a charge of powder inserted into it. It was then placed in a hydraulic press, and the powder fired by electricity. This operation was repeated until the cylinder gave way, and the proper quality of steel was obtained by the number of charges required to burst it, and the increased diameter of its central part, which swelled out with every charge until it became as thin as paper. It was during these experiments on steel from various makers that he discovered a great want of uniformity in the quality of steel, which he at once tried to get at the bottom of by building a small steel works in his own premises; and from these experiments came forth his patent for casting steel under compression.

And from that his great invention of casting steel cylinders, or as it may be better said, of running steel into hollow castings under compression.

Mr. Whitworth spent a great deal of time and money over his experiments on artillery, and demonstrated by his correct shooting at enormous distances the truth of the principles he had discovered with his rifle, but the government refused his ordnance as they had refused his rifle, and Sir W. Armstrong became the head of the gun factory at Woolwich.

But a few years and his lead-coated shot and his coiled barrel were condemned, and guns with steel liners heavily hooped took their place.

The later years of Mr. Whitworth were spent principally in working out his great invention of casting steel. Some other notable things he also did, one of which should not be forgotten by engineers, the large sum of money he provided to train a school of young engineers. For this great gift he received a baronetcy. It was a poor little thing to give such a man; surely, there was no gift within the Crown of which he was not worthy. I have said that the last years of Sir Joseph's life were spent in improving and perfecting his system of casting and of forging steel.

Like every thing which he did, he determined to excel in this business also, and those who know anything about the difficulty of casting steel in large masses, and of heating and hammering it up to perfect form, can appreciate the workmanship on the hollow intermediate propeller shaft, partly turned and partly rough from the swage (to show the little required to be turned of [illegible] inch of a side) and the large steel cylinder liners, surely they were the finest forgings ever seen, I said to myself over and over again, as I looked on them at the great Exhibition on the Champ de Mars.

Some six or eight years ago, Sir Joseph Whitworth sold his works, lying in the center of Manchester, for a large sum of money, a very old man with one leg in the grave, and with the great reputation he had made.

Surely he ought to have retired to his beautiful Derbyshire home, approaching his eightieth year, the owner of a great fortune and with no children of his own to inherit his great wealth, but the love of work led him to use a great sum of money to build new steel works in the outskirts of Manchester.

And the marvel about the perfect forgings exhibited in Paris was this, that they were not produced by the great well-known forges of Leeds or Sheffield, or the great firm of Krupp, but by a weak, old, infirm man, nearly 80 years of age, who had had no early training for this kind of work, or had done any thing in forging till he was over 60.

I spoke in the beginning of this sketch of some of Sir Joseph's contemporaries, for many of these I have as high a respect as I have of him, but measured with him I think he was the greatest of them all, and especially when we think of his great disadvantages; first a very feeble body, and second a very poor education; what distinguished him particularly was the steady, determined, dogged resolution never to give up a thing till he had mastered it, and never to leave off at any thing short of perfection.

A close-fisted, screwing kind of a man, with no extravagances, practicing the strictest economy in every way, he soon realized a large fortune, and was able to indulge to his heart's content in experiments and in new inventions, which he never divulged till he had got them completed. He was what the Scotch call pawky, he was very secretive, and in some ways gave you the idea that he was a cunning man, who wanted to get from you all he could and give you back as little as possible. I often used to go and see him in his house in London, and visited him at his house in Derbyshire. He was a good conversationalist in matters mechanical, was very much interested in the progress of mechanical science in America and as to what I had seen in the Great Exhibition of 1876. He had visited America himself many years ago, but could tell me little about anything except Niagara, the view of which, he said, was worth all the journey.

I have no doubt but that his life was prolonged for so many years of delicate health through the care and devotion of Lady Whitworth, his second wife, and much younger than him, who studied his least wants and ailments as if he were a little child. As I remember her at Stanncliffe Hall, she stands before me the perfect type of an English matron, a true accomplished lady whose every look and word and action showed her interest and care for her invalid husband. He was often wayward and would not take care of himself, while she nursed and slaved to get and keep him strong and well, and my belief is that while he did the planning of his great work, the great scheming brain which never rested would long ago have ceased it labors had it not been for the watchful care of this beautiful woman.

He never took a holiday, said Lady Whitworth to me; he was to take one on our wedding day, but he never got it. Some business took him off, and so it has been ever since; always scheming, always planning some new thing. Sir Joseph Whitworth must have collected an immense amount of the most valuable information about steel, but which has never been published. He has given very little to the world through his pen. Let us hope his life will let out some of the secrets which up to this time have been so carefully hidden.

How differently Sir William Fairbairn acted with his experiments, which were all published and became the property of the profession as soon as made, and it is just here that Fairbairn stands so much higher than Whitworth.

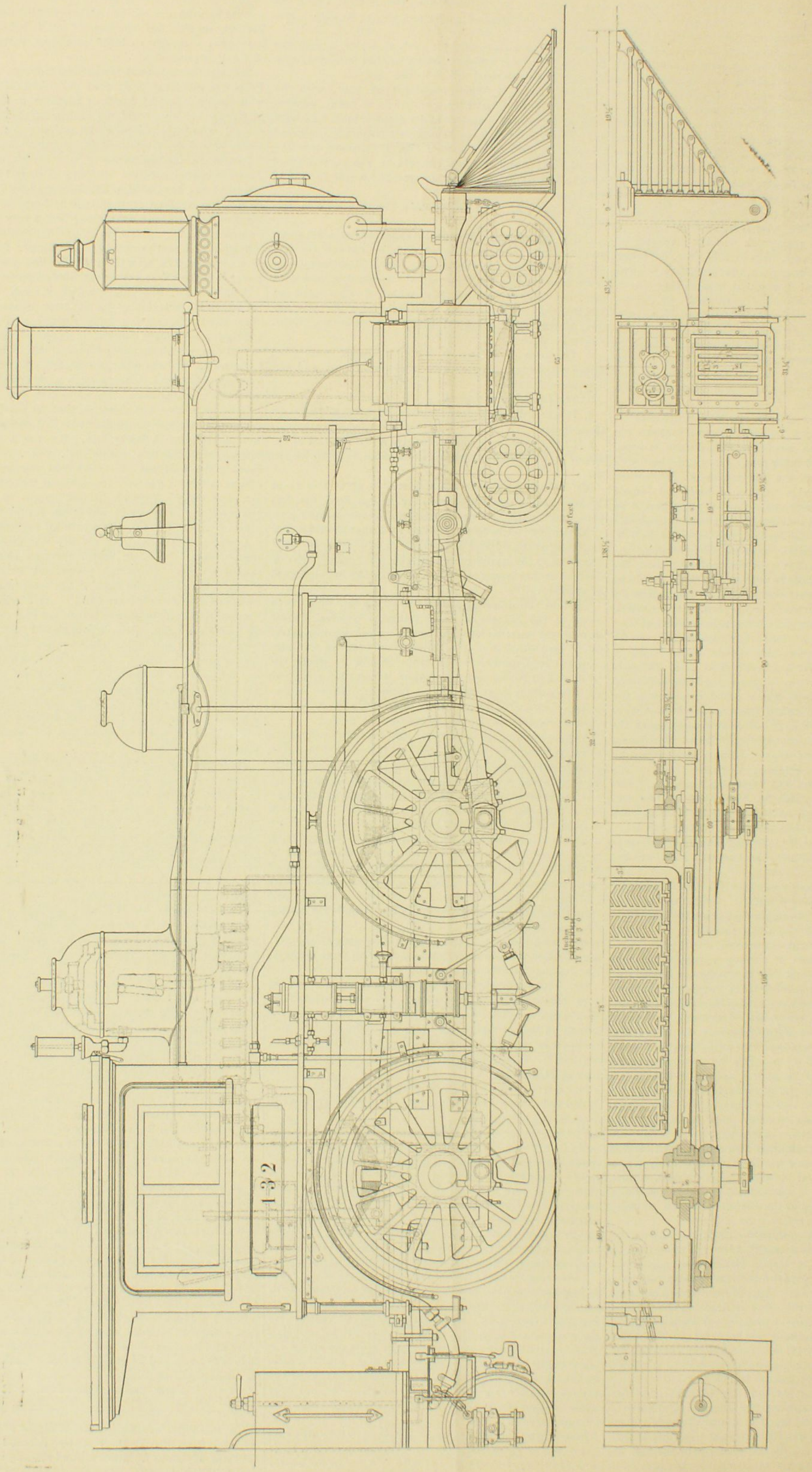
"I want you to write something for me," he said to me one day, but I said, "As the inventor of the thing you want me to write about, a letter from you would be much more effectual." "No," he said, "I cannot write; do this thing for me." Then I said, "What shall I say?" "Oh! what you like; I like to read your letters." And in due time my letter appeared, which he highly approved of.

The work of Sir Joseph Whitworth will outlast all his contemporaries, Fairbairn's masterpiece, the Menai Bridge, will never be repeated. Swifter and greater ships plow the Atlantic than Robert Napier ever made, at no distant date the heavy rolling mill and the hydraulic press may set aside the work of the N smyth hammer, but Whitworth's true plane surface is perfection. No man can set it aside for something better. His system of fine measurement, and his machine to measure to the one-millionth part of an inch, is as fine in its dimensions as will be required for many generations. What the future of his inventions in the manufacture of compressed steel may be, no man knows, for all his experiments are as a sealed book to the profession. But up to this time the most difficult, the most complicated, the most novel, the most perfect forgings have been made by him.

Surely this man should be laid among England's great sons. He was in every sense of the word a noble Englishman, and in every sense one of the greatest mechanics that ever lived, and he devoted his life to make every thing he could touch perfect.

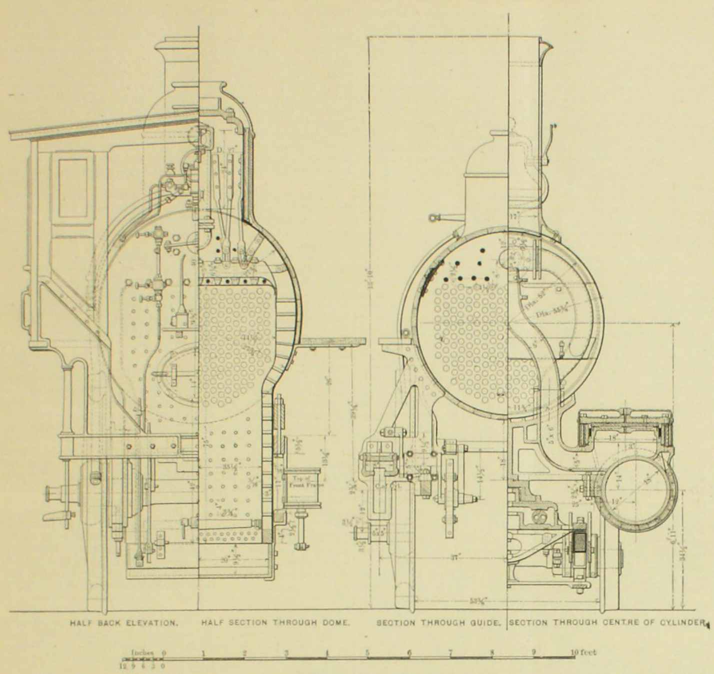
JOHN FERNIE, Mem. Inst. C. E., England.

MR. ROSWELL MILLER, general manager of the Chicago, Milwaukee & St. Paul, recently donated twenty-one volumes of books to the railroad reading-rooms of Milwaukee.



PASSENGER LOCOMOTIVE—OLD COLONY RAILROAD.

Designed by MR. J. N. LAUDER, Superintendent of Rolling Stock. Built at the Company's Shops, South Boston.



PASSENGER LOCOMOTIVE—OLD COLONY RAILROAD.

Our engravings illustrate a standard passenger locomotive of the Old Colony Railroad, designed and built in the company's shops at Boston by Mr. James N. Lauder, superintendent of rolling stock. The engine throughout displays as fine proportions as any locomotive we have ever examined. The weight of fast passenger trains on this popular route between New York and Boston has been steadily increased for several years, and the demands for punctuality are very exacting, so that a heavy type of locomotive was necessary to do the work satisfactorily, and led to the designing of this standard. In running order, this engine weighs 96,000 pounds, of which 61,700 is on the drivers. The cylinders are 18 × 24 inches; drivers, 69 inches diameter; boiler, 52 inches diameter at smallest ring, wagon top type, with a total heating surface of 1,448 square feet, and constructed to carry 175 pounds of steam per square inch as a working pressure.

The Old Colony Railroad Company are following the wise policy of abolishing as rapidly as possible crossings at grade, a change which serves to reduce the number of stops a fast passenger train must make, but it is still important that an express train engine should have the tractive force necessary to urge the train quickly into speed, and the engine shown in our engravings possesses this power in a marked degree. With the ample steam passages that this engine has, a mean effective cylinder pressure of 150 pounds could be depended on for starting when the boiler pressure is 175 pounds. Figured by the ordinary formula, this would enable the engine to exert a force of nearly 17,000 pounds to turn the wheels. We estimate that the engine will be able when working with the lever in the 7 inch cut-off notch to maintain a mean effective cylinder pressure of 40 pounds while running at a speed of 50 miles an hour. This will enable the engine to pull a train of 400 gross tons at that speed on a level. This great power makes the engine capable of doing most of the work while well linked back, an arrangement that reduces the consumption of coal to the lowest possible limit. The engine is running the heavy steamboat trains with a coal consumption very little above 30 pounds to the train mile. The high measure of heat economy represented by this record is obtained by the combined efficiency of boiler and cylinders. The boiler and fire-box have close on three square feet of heating surface to each inch of piston area, both pistons being included, a proportion which will be understood by engineers as being very liberal.

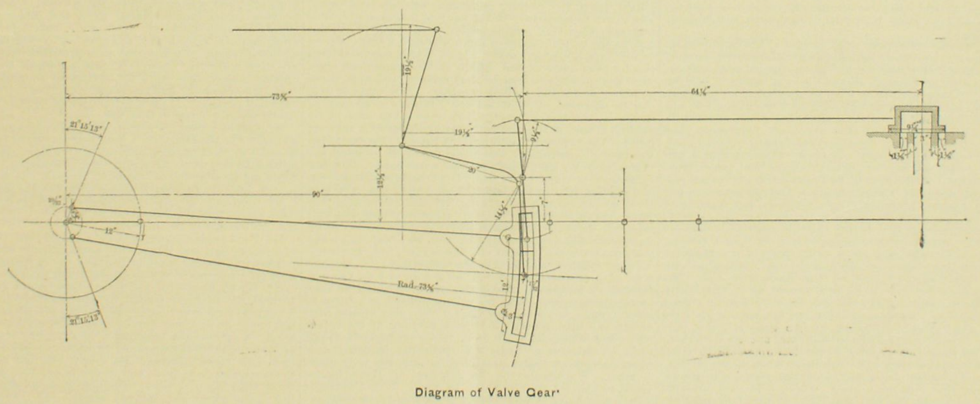


Diagram of Valve Gear.

Table Showing Distribution of Steam, Locomotive 132, Old Colony Railroad.

FORWARD END.

Left Side. Notch.	Lead.	Cut-off.	Release.	Suppression.	Right Side. Notch.	Lead.	Cut-off.	Release.	Suppression.
1	1/32	20 13/16	23 1/8	7/8	1	1/32	20 3/4	23 3/32	29/32
2	3/64	20 5/16	22 13/16	1 1/16	2	3/64	20 1/8	22 7/8	1 1/8
3	3/32	18 5/16	22 3/16	1 13/16	3	3/32	18	22 1/8	1 7/8
4	9/64	16 1/4	21 3/8	2 5/8	4	9/64	15 7/8	21 1/4	2 3/4
5	11/64	13 1/4	20 1/8	3 7/8	5	11/64	12 1/2	19 7/8	4 1/8
6	3/16	10 1/8	18 5/8	5 5/8	6	3/16	9 3/4	18 5/8	5 5/8
7	7/32	7 5/8	17	7	7	7/32	6 7/8	16 5/8	7 3/8
8	15/64	4 11/16	14 7/8	9 1/8	8	15/64	4 1/4	14 11/16	9 5/16
Center	1/4	3	12 13/16	11 3/16	Center	1/4	2 5/8	12 5/16	11 11/16

BACK END.

Notch.	Lead.	Cut-off.	Release.	Suppression.	Notch.	Lead.	Cut-off.	Release.	Suppression.
1	1/32	20 13/32	23	1	1	1/32	20 9/16	23	1
2	3/64	20	22 7/8	1 1/8	2	3/64	20	22 7/8	1 1/8
3	3/32	18	22 1/16	1 13/16	3	3/32	18	22 1/16	1 13/16
4	9/64	16 1/16	21 5/16	2 11/16	4	9/64	16 1/16	21 5/8	2 5/8
5	11/64	13 1/4	20 3/16	3 13/16	5	11/64	13 3/16	20 1/8	3 7/8
6	3/16	10 3/16	18 3/4	5 1/4	6	3/16	10 1/16	18 3/4	5 1/4
7	7/32	7 3/16	17 5/16	6 11/16	7	7/32	7 1/16	17 1/4	6 3/4
8	15/64	4 7/16	15 5/16	8 13/16	8	15/64	4 5/8	15 1/4	8 3/4
Center	1/4	2 1/2	13 1/8	10 1/8	Center	1/4	2 1/2	13 1/8	10 3/8

Mr. Geo. W. Cushing, of the Northern Pacific, has given the proportion of boiler capacity to cylinders close attention for many years, and the conclusion arrived at by his experience, experiments and records is, that a locomotive boiler to supply steam freely must have at least 1 inch of flue opening area to .96 inch of piston area. The Lauder engine has 1 inch of flue opening area to .94 inch of piston. The engine has a well-designed valve motion, which gives a very even distribution of steam, as may be seen from an examination of the annexed table. The small increase of lead that follows the hooking up of the engine to the 7-inch cut may be noticed, a result which is due in a great measure to the long radius of link, 73½ inches. The steam ports are 18 inches long by 1¼ inches wide, and the exhaust port is 18 × 3 inches. The eccentrics have a throw of 5 inches, and the valves, which are balanced by the Richardson device, travel the same distance.

Among peculiarities of the engine may be mentioned the guides and cross-heads, which are of the Dean pattern illustrated in the Railway Master Mechanics' report for 1885. Mr. Lauder assures us that this style of guide is a decided success. The exhaust pipes are formed in two branches, which join by an easy curve, an arrangement made to reduce the obstruction to the flow of gases out of the flues. The mud ring has double rows of rivets, a plan of construction which Mr. Lauder has been advocating

for some years. The boiler and fire-box are of Otis steel throughout. The longitudinal seams are double-riveted with welt. The shell of the boiler is $\frac{7}{16}$ inch thick, crown sheet of fire-box is $\frac{3}{8}$ in. thick, and is supported by crown bars re-enforced by sling-stays. The side sheets of fire box are $\frac{5}{16}$ inch thick and the tube sheets $\frac{1}{2}$ inch. The tubes are 11 ft. 6 in. long. The annexed table gives particulars of the steam distribution.

New England Railroad Club.

CAR HEATING.

The regular monthly meeting of the Club was held at its rooms in Boston, Feb 1.

The President, Mr. J. W. Marden, announced the subjects for discussion to be car heating and lighting, and suggested that the heating be disposed of first.

Mr. Marden described a recent accident on the Fitchburg road, in which some cars with Baker & Spear heaters were overturned, but the cars did not take fire, nor was any one injured by hot water.

Mr. Lauder alluded to the attacks that had been made upon his position at the last meeting because he had advocated the claims of individual heaters. He thought that the terrible lesson taught by the Vermont disaster ought to lead railroad men to approach the subject of car heating with the greatest care, and cause them to listen to and accept ideas upon the safe heating of cars that will tend to make traveling safer. While, however, it may be possible to heat a train with steam drawn from the locomotive on the continuous system, it will take a long time at the best to introduce it in general practice, even though it may be above criticism from a mechanical standpoint. Meanwhile we will be obliged to heat the cars individually, and this I believe to be safe. I have stated that I considered the Johnson and Baker systems safe, because no fire, as far as I know, has been kindled by either one of them; but in the Vermont disaster, the Concord car, which was new, and had a Baker heater fastened in the most approved manner, was fired by it. The case has now come to stand in this way, that the public are demanding that a change shall be made, and the railroads will be obliged to meet them, for these diasters must not be repeated. It seems that it would be perfectly feasible to so encase a heater with boiler plate that it will be absolutely safe. For if the case were made of homogeneous steel it would be strong enough to resist the blows and shocks that would fall upon it in a disaster. We are not here to talk about the cost, and the railroads will not consider it, for even though made in the manner specified the cost will be trifling. There will be no experiment about it, for when built the vault has nothing to do but take the upset when it comes, and render the fires harmless. The difficulty that has been suggested in connection with this scheme, that an accident may occur at the very time when the doors are opened for attention, can be obviated by issuing imperative orders that the doors shall in no case be opened except when the train is standing.

Mr. Adams reiterated what he said at the last meeting, that he was convinced that steam was the coming method of heating. Heretofore it had been the general opinion that individual heaters offered the only means of heating a car. There are, it is true, many objections to steam heating, as Mr. Lauder has said, such as cutting off and putting on. But it will be found that when these difficulties are grappled with they are easily overcome. The question is occupying the attention of many railroad men, and the Boston & Albany officers are satisfied that it will be necessary, at last, to come to steam heat taken from the engine. And this will be done, for the two vital reasons of necessity and economy. Our experience has shown nothing particularly new since the last meeting of the club, except to demonstrate the value of the system; and it is probable that before the cold weather is over we will have another train equipped on the same system. While the heater has given us no cause of complaint or criticism, there are a few changes required. Still it has been remarkably successful and no trips have been lost. The Baker does not show so good a record, as it frequently calls for the running of a car into the shop for the repairs or renewal of the pipes, and it is not uncommon to have from one to three in the shop at one time for this purpose. Some roads may have had better success with them than we have, but we have found it impossible to train the men so that they will at all times keep up the circulation. And when this is not done, the pipes will freeze. To meet the objection raised, where cold cars must be taken on a train, we find that most of our buildings are heated by steam and it will be a simple and economical matter to put in boilers for heating the smaller stations; then it is merely a matter of making the connections. Again the amount of coal used in the individual heaters is very large and will cost on an average at least $50 per car for the season. With the continuous system, on the other hand, the engineer can see no addition to the amount of coal used and no diminution in the pressure of steam in the coldest weather. On a cold day, recently, when the thermometer stood at 25° below (?) zero, I boarded the train at Framingham, and found a temperature of 70° in the car. I disagree with the advocates of the individual systems because this is the cheaper. The older methods heat unevenly. A car will be hot in the immediate vicinity of the heater while at a distance it will be cool. Now with the one under consideration, nothing of the kind occurs, and the heat is kept even throughout the whole car, allowing the ventilators to be opened. There might be a difference on the Western roads, where the runs are long, but in the East there can be no difficulty with it. As for the necessity of uniformity, the continuous system stands in exactly the same position that the Westinghouse brake did at the time of its introduction. It will therefore be necessary to act in the same manner, and have couplers that will interchange. I believe that steam heating will come into general practice within the next five years.

Mr. Robert Miller, of the Michigan Central, said that the principal objections that he saw lay in the necessity of having a regular plant at all of the terminals, and that if an engine fail another must be on hand to take its place. These could be provided for; but if the train were caught in a blizzard and stuck in a snow bank, it would seem that the individual heater would be the safest and best. In New England these contingencies do not occur, and the objections are more easily overcome than in the West. On short-run and suburban trains there will be no difficulty at all. On through trains, the heater adopted must be universally adopted, or else auxiliary heaters must be placed in the cars. We have thought the matter over, and have come to no decided opinion. In the old countries they have no heater at all beyond a pan of hot water, which will be renewed from time to time on a long run like that from Paris to Vienna. This is too crude an arrangement to present to the American traveler. I have thought that as coal may be produced by chemical action, heat might be generated in the same way. It seems as though the hot water heaters could be placed in cars and be safe. The Johnson heater seems especially worthy of commendation in that it has the cast-iron cover which will be readily broken and the fire extinguished; the same thing might be done by the use of a fusible plug.

Hon. J. T. Woodward, of Augusta, Me., gave a brief resumé of the work done in perfecting the Sewall heater. He was followed by Mr. Sewall, who described its mechanical construction. Steam is taken from the engine and may be either exhaust or live. With a 16 in. × 24 in. engine working with the reverse lever down in the corner, a back pressure of 40 lbs will be shown. As the cut-off is made earlier it becomes less. Now the idea is to take this steam and store the heat that it contains. It is passed back to a place at the foot of the dome. A dry pipe there intersects a valve with different areas, giving a greater opening to the exhaust than to the live steam. This valve is so arranged that when the engine is sent off the valve closes on the exhaust and opens on the direct pipe, so that a uniform pressure on the pipe is obtained. It is not necessary to use the exhaust steam at all, and the whole supply may be taken from the live steam, or it may be taken from any convenient source whatever. From the locomotive the steam passes to the first car, where there a coupling, and thence to the center of the car. At this point there is a valve, the handle of which is in the form of a disk, and to which a wrench may be attached, and the valve worked in the same manner as an old-fashioned lazy cock. The disk carries a pointer and the rim is marked with an S and an O. When the pointer is at S the steam is shut off from the car, and O it is opened on full head. At intermediate points the valve is opened more or less. This in no way interferes with the other cars. The manner of piping is to run three lines along each side, doing away with all convolutions. It was thought best to adopt this system on account of the lessened danger in the case of a collision where the cars are badly smashed. With the present methods the U's under the seats simply serve as an additional means of injuring the passengers and pinning them in their seats. We have tested the heater at all temperatures from 40° below zero to 50° above; and at no time has there been any necessity of the car thermometer showing more than 70°. We do away with the fire entirely, and the whole apparatus is so simple that any man can take care of it. We test the couplings and hose up to 300 lbs. to the square inch, with hydraulic pressure, and have failed to produce a leak. The construction is such that when the cars are uncoupled and pulled apart the coupler automatically does the same. The steam pressure used in the car is of low pressure. For instance, when the engine boiler is carrying 155 lbs., a hole in the boiler the size of a pin will heat a train of four or five cars. We have taken a train of cars equipped with the Johnson heater, and which it has heretofore been utterly impossible to heat by that system, and kept them comfortable in the coldest weather. The waste or drip can be disposed of in two ways. It may be allowed to escape at the rear through a trap or be taken care of by putting it back in the tank or boiler by means of a vacuum pump. To overcome the objections raised to the system in the case of cutting off and in the use of an isolated car in the train, we have what we call a hot well. This is a smaller reservoir of boiler iron placed underneath the car, and holding four or five pailfulls of water. At a certain level we place a trap for taking off the excess after the water has reached that height. In connection with this reservoir there is a fire-box whereby it may be used as an independent heater for warming the car, keeping up the temperature when it is cut off, or even for heating when it is found inconvenient to take the steam from the locomotive. For ordinary use we place a $\frac{3}{8}$ in. or $\frac{1}{4}$ in. valve at the engine, and in the case of the one upon which we have been experimenting, the $\frac{1}{2}$ in. valve required ten turns to open it wide, but when we used it we only opened one-eighth of a turn, making the actual opening of the valves about one-hundredth of an inch. In a completely equipped train it would run perfectly well with the Martin or any other continuous heater, provided the couplers were made to mate. We can also use the Johnson or Baker heater pipes, but prefer to put them in new. With the Baker where salt water is used there is always more or less corrosion, and we do not have so much, especially in Maine, where we use the heater almost every month in the year. I neglected to state that we use three $1\frac{1}{4}$ in. pipes on each side of the car.

In reply to a question, Mr. Sewall stated that steam would circulate through the car at about the speed a man would walk, and in exceedingly cold weather it might take from 30 to 40 minutes to warm the car to 50°. With the auxiliary boiler, and the thermometer standing at 14° below zero, it had been found possible to heat the car to 65° in an hour; but we only use this in cases of emergency. The reservoir also acts as a storage, as shown by the following experience: At the end of a run of 85 miles, the car was left standing from ten in the morning until two in the afternoon, without any other means of heat than that stored, and at the end of that time the car has always been so warm that we have never had a passenger complain of chilliness.

Mr. Griggs, of the Providence & Worcester, said that he had been using steam for heating for three or four years, and had used different heaters. He could see no difficulty with taking steam from the locomotive for the purpose, especially in his own case, where no exchanges were made with other roads, and also from the fact that many of the stations along the road are already heated with steam.

Mr. R. B. Owen, representing the Smith & Owen Heater Co., of Detroit, was called upon, and, confining himself strictly to the mechanical construction of his heater, he refrained entirely from any laudation of its merits. With the aid of a sectional view, he explained that until recently he had aimed at producing heat, and had not paid especial attention to protection from fire, but now they had taken that also into consideration. The heater consists of a boiler $15\frac{1}{2}$ in. in diameter and 42 in. high, made of $\frac{1}{4}$ in. homogeneous steel. There is $1\frac{1}{4}$ in. water space all around. The boiler stands flat on the floor, and has a rim of $2\frac{1}{2}$ in. angle iron riveted at the base, by which it is bolted down. There is a coil of pipe in the central portion, and the fire is fed through a door below it. Formerly the coal had been put in at the top, but it has been thought adviseable to change to the method described. At the bottom of the ash door, and above the feed door, there is a band of 2 in. angle iron to which strong doors are attached. These doors have $\frac{3}{8}$ in. perforated openings, and serve to keep the fire from falling out in case of accident. Above the coil there is a dome into which the former opens. The feed is brought downward. In the dome there are four 3 in. flues, and the whole is covered by a $\frac{1}{4}$ in. perforated steel plate. The perforations are $\frac{3}{8}$ in. in diameter. The whole is cased in Russian iron, giving an air space of $1\frac{1}{4}$ in. I may add that we have one heater in use supplying 602 feet of pipe.

Mr. Adams said that though he came to the meeting thoroughly convinced of the merits of steam heating and its practicability, he believed in it more than ever, and thought that any reasonable man ought to be convinced of it also.

Mr. Edward Gold explained his method of steam heating. He said: My heater is similar in many respects to others, except in this one respect of storing the heat, which is necessary at times, when the engine is detached. My system is used on the elevated roads in New York, on the Long Island, the Staten Island, the Providence, Warren & Bristol and the Westchester suburban road (New York), 900 cars in all. The storing consists simply in placing one pipe inside another; the outer pipe four inches in diameter, the inner pipe three and a half; the latter nearly full of salt water. These are placed on the side of the car. When the steam is turned on, it stores the heat in the water and heats the cars simultaneously. As soon as the steam passes through the storage cylinder, which requires about two minutes, the water is boiling hot in the inner pipe. That is sufficient to heat the car for about two hours. The Hoboken elevated cars are heated by a stationary boiler, and the steam is turned on once in every two hours for about three minutes. We use a lock coupling, similar to that in the Westinghouse air brake, and rubber hose between the cars. If we have a stationary boiler at a station we can get heat enough to run 100 miles and not draw on the engine at all. It requires very little steam to reheat it. In going down a grade, if you have extra steam, that can be turned on, and the blowing-off steam can be utilized. We can shut off the heat on one side of the car, and heating one side is ordinarily sufficient. We can heat ten cars at once. The engineer on the Staten Island road says, with seven cars, he perceives no difference in the amount of steam used. The condensation is about 20 pounds per hour per car. The system has been in use about four years and has been thoroughly tested. Cars can be kept warm five to seven hours after being detached.

Mr. Gold (replying to Mr. Lauder): We can easily heat 12 cars, if necessary.

Mr. Peck: We have a simple device, a casing designed to cover any heater or fire-box, for safety. It works automatically, and was invented by Mr. Stevens. You will see by this model (model placed upon the table) that it is simply a casing made of boiler iron, with a head of the same material at each end, and may be cylindrical or of any other shape, and is strong enough to resist great pressure from without. There is no cast iron about it. It has apertures above and below for the hot air to escape and the cold air to come in, and these open and close by the same automatic action. If the stove should be broken, the fire would be imprisoned in this case.

Mr. Lauder called the attention of the continuous heater advocates to the fact that it would be necessary for them, in order to meet the demands of the Boston roads, to heat at least twelve cars; and one that would not do that, could not be adopted. Even now, he said, the Boston & Lowell road are running fourteen cars on some trains.

Mr. Stone, of the Providence, Warren & Bristol Railroad, stated that the Sewall heater had done well in the trial on the day of the meeting.

Mr. Peck explained and showed a model that they had of a casing that was intended to automatically enclose the heaters in a strong shell in the case of on accident, and shut off all access of the air to the fire or interior.

Mr. W. C. Baker, of the Baker Car Heater Co., said: In 1869, the first car heated by hot water ran from New York into your depot here. Since then this (Baker) heater has found its way into almost every first-class car in the land. A great many lives and a vast amount of car property have doubtless been saved by it that would have been lost with stove heating. Its merits are best known to those who know it most, and its faults are best known to those who know it least. Heating cars by steam from the locomotive is talked about just now as if the idea was a new one. Cars have been heated in this way for a number of years. No new and desirable feature, I believe, has been presented by the advocates of this system, but on the contrary, all their appliances seem to be complicated, expensive and inferior in every respect to those long in use. I am not opposed to the broad principle of generating the heat outside of the car, but I do know from long practical experience that with the present equipments of the railroads of the country it is utterly impracticable to use the steam for this purpose from the locomotive boiler. It is only adapted, and with many drawbacks at that, to suburban travel.

All the cars of the four lines of the elevated roads of New York City have from the first, about nine years, been exclusively heated by my system of heating by taking steam direct from the same source as the engine. Soon after completing the then 700 cars of this road, I undertook, with all the assistance the New York Central could give, to warm the through passenger car trains running between the Grand Central Depot and Tarrytown. But, after an entire winter's trial, the scheme was abandoned. I think it was a year after that that I made another unsuccessfull trial under the auspices of Gov. Henry Howard between Providence and Wickford Junction. I should state that the best results of my system are on the New York Elevated road, and are very much interferred with by changing, by others, for some unexplained reason, of the orignal sand-packed radiators, which I use to lessen the quanity of steam taken from the locomotive, as well as deaden the excessive heat of the steam carried—about 130 lbs to the square inch. The main objection to this system is the amount of steam taken from the engine.

The assertion that it takes no more steam to draw and heat a train than it does to draw the train alone, is ridiculous. The present locomotive boiler is built only to run the engine and draw the train. I found that a half-inch pipe, inside diameter, was required to supply steam

for an elevated train of four small cars. Now, what engineer will state that a half-inch "blow out" from his boiler will not, like a safety valve, soon drop the pressure. There is no saving of fuel by this plan, but waste rather, as, unless the car is kept warm, certainly the frequent recurrence of cooling the entire woodwork of the car, making them radiators of cold instead of heat, will draw more on the steam for re-heating than if heat were kept constantly on. Every particle of steam from the locomotive boiler represents so much hot water, and that at a temperature of about 300°; and every drop of the water represents its equivalent in coal or other fuel. I have calculated that to heat a train of twelve 55 or 60 ft. cars in very cold weather would require more steam than to haul them."

Western Railway Club.

This club met at the Grand Pacific Hotel, Chicago, Feb. 16. President Scott was in the chair. There were present 122 members and visitors.

Mr. G. W. Rhodes submitted an account of the proceedings of the last meeting of the Master Car-Builders' Committee on Freight Car Brakes, and the new rules for the Brake Tests, which will be found on another page.

Mr. Rhodes said: This brake test has a bearing on another thing that is just now calling for a good deal of attention which seems to be inseparable from the brake test, and that is

THE COUPLER QUESTION.

It was found that at the Burlington test the slack in the train made it dangerous to handle it in the way they were handling it and it made a very bad point for the brakes, because a railway company would say, "We can not use your brakes because of the violence that is communicated through the train by the loose couplers." The brake companies realized that, and they have so perfected their brake apparatus that they now expect to be able to make close, quick and rapid stops with loose couplings without having the shocks and jars that we get if the brakes don't go on quickly and rapidly. These brake tests are railroading in every sense of the word. Here for the first time we have men who are not influenced at all by any particular coupler, and they have taken a particular type of coupler and said that they proposed using that type. I do not at all say that it solves the coupler question, but think it has an interesting bearing on that.

Another question which is equally interesting, I think, is the matter of the train. At a meeting in New York recently of the Master Car-Builders' Club, the question of starting the trains with close couplers and loose couplers was taken up and discussed very freely, and many there seemed to think that the Burlington tests did not prove conclusively that as long a train could be handled with close couplings as with loose ones. One of the rules prescribed last year was that after each stop the rapidity with which the train got away from the stop would be taken note of by the committee. Several of the brake companies objected to that, saying that it was a large train and a small engine to handle it with, and after making a stop the small engine wasn't able to handle the train, and therefore the brake was going to be credited with not throwing off quickly because the train couldn't start up quickly, whereas the fault really lay with the engine and not with the brake. I cite that to show that the brake companies realized that very fully. Nevertheless, they went to the Burlington brake tests, and they found that with a link and pin coupling the engine could handle the train and get away promptly, and consequently it was not the fault of the engine. They have such confidence in those tests made last year that they specify close couplings and fifty cars. I hope that the members of this club will bear in mind the close relation that the automatic coupling question bears to the brake question, and we expect that this test will bring out a great deal of information, not only with regard to brakes, but also with regard to the subject of automatic couplers.

HEATING OF RAILROAD CARS.

President Scott explained that owing to a report that Mr. C. E. Smart could not be present to introduce the subject of weight of driving wheels, the executive committee had dropped the subject and substituted Methods of Car Heating. He suggested that that subject be taken up first, and called on Mr. Allen S. Cooke to introduce it.

Mr. Cooke had no new system to propose, but thought recent events had decided that something better than the dangerous stove must be provided as a means of heating cars.

The Secretary read letters from the Gold Car Heating Co., New York, and from the Emerson Car Heating Co., of Springfield, outlining their systems. He also read a letter from Mr. S. S. Boyce, editor of the Chicago *Journal of Commerce*, proposing heating the cars with gas.

Mr. Wm. Barr, Chicago, Milwaukee & St. Paul Railroad, mentioned that they are trying two systems of safe car heating, the Martin and the Westinghouse. Have a train fitted up with the Martin system. Neither system has been used sufficiently to decide on their merits.

Mr. Wm. Martin, of the Martin Anti-Fire Car-Heater Co., was called upon for his views, and he described his system, which is already familiar to our readers. This system of heating cars from the locomotive he said had been in use for three winters, and he never had to take down a single pipe owing to damage from frost. The cars are heated comfortably, and he is prepared to put in his apparatus and make no charge unless it works as represented. In reply to questions he said that if cars are left at way stations, means must be provided to supply them with steam. Emergencies must be provided for by special means. The cars in using his system on the Chicago, Milwaukee & St. Paul road, condense 8½ gallons of steam per hour.

Mr. W. A. Scott, Chicago & Northwestern Railway, inferred from what had been said that a boiler must be kept to supply steam at roadside stations where passenger cars are set off.

Mr. G. W. Rhodes, Chicago, Burlington & Quincy, thought that similar problems had come up for solution before. When electric lighting was introduced, the impression at first was that gas would be dispensed with, but in practice both gas and electricity are used. Something similar probably will be done in heating cars, steam and stoves may be used in combination. But it must be a stove with the danger of setting fire to wrecks overcome. There is no tendency of the fire in a locomotive to cause the burning of things in a wreck, because the fire in this case is well protected by steel sheets. Stoves could be made equally safe, or could be arranged so that the fire would be extinguished.

Mr. Barr, in reply to a question from Mr. Snow, described the Westinghouse system of car heating.

Mr. Mead, Chicago & Atlantic, believed that any system that could be introduced would be certain to present difficulties and drawbacks, but experience will teach all concerned how to overcome them. Thought that stoves and steam should be used in combination.

Mr. J. Townsend, Chicago & Alton, perceived danger of injury from explosions in connection with steam heating.

Mr. Barr explained that the pressure of steam was so low that no danger from explosions existed.

Mr. Mead asked if the reducing valves acted automatically, and was answered in the affirmative.

Mr. Angus Sinclair said there could be no danger of explosions with steam when it was apart from water. The quantity of compressed steam in the pipes could not do harm when passed into the large car. Public sentiment is saying that the stove must go, and it is the duty of railroad men to find a better method of heating. There is no department of railroad business where less improvement has been made since railroading began.

Mr. Wm. Forsyth, Chicago, Burlington & Quincy, estimated that twelve cars could be heated by the steam represented by twenty horse-power, which most locomotives could spare. They are now using the new Baker heater very successfully. Thought it possessed an advantage in being away from the ends of the car, as it is not so liable to get smashed in an accident. They are also trying a heater similar to the Westinghouse, and are watching to find the success others meet with in trying to find something safe to take the place of the stove.

Mr. Henry Schlacks, Illinois Central, did not see how they could apply the Martin system to their suburban cars, as the cars are dropped off and taken on at a great many places.

Mr. Robert Quayle, Chicago & Northwestern, was decidedly opposed to stoves, and wanted them abolished. Had no fear but steam or some other method could be worked out successfully.

Mr. John Kirby, Lake Shore & Michigan Southern, said the subject of car heating had taken a wonderful change in four weeks, and many of us are prepared to take strong ground in the course to be pursued to warm our cars. Had just given an order to put the Martin heater on the cars of a suburban train. As to the difficulties connected with a new system, he said there was hardly any thing that the inventive mind of the Yankee will not overcome.

Mr. S. Pullman, Chicago, Rock Island & Pacific, said they are using 100 Baker heaters, and are now applying the Westinghouse heater to some cars.

Mr. Scott was strongly of the opinion that the stove must go, for the public has condemned it. He did not believe in half-way measures, and considered it was the duty of railroad men to make a new system successful.

The discussion was closed at this point and the Interchange of Car Rules taken up.

Mr. G. W. Rhodes opened the discussion on rules 15, 16, 17, 18, 19 and 20. A few minor changes were recommended. Messrs. Barr, Townsend, Snow and Mead participated in the discussion.

The subjects for next meeting will be Methods of Car Heating, to be opened by Mr. Wm. Forsyth, and Interchange of Car Rules, to be opened by Mr. Mead.

Master Car-Builders' Club.

The regular monthly meeting was held at the rooms of the club on Thursday evening, Feb. 17, the subject for discussion being the Heating, Ventilating and Lighting of Passenger Cars. The time was almost exclusively occupied by Messrs. Baker, Smith, Emerson, Gold, Owen and others, in advocating and explaining their respective heating devices, the merits of which are so fully set forth elsewhere in our present issue, that it is not necessary to repeat what is already accessible to our readers.

Experiments with Car Heaters.

The Chicago, Milwaukee & St. Paul Railroad Company began experimenting before the Rio accident to find out a safe and practicable car heater. Their engineer of tests, Mr. George Gibbs, has been engaged in working up the matter, and has looked into every system of car heating in use. He has charge of the train equipped with the Martin Heater, and is making careful records of the work performed. In the course of a recent interview with a *Chicago Times* reporter on the subject of his work in this department, he said:

"So far we have had no difficulty in keeping the train which has been fitted with steam heating apparatus and run between here and Chicago well warmed. The only trouble during the recent rise in the temperature has been to not get the cars too warm. But as yet we have proven nothing. The great difficulty which we have to meet in this extreme climate is the freezing of the joints in the couplings through escaping steam and water and the icing up of the traps through which the condensed water is allowed to run off. The question of steam supply is very easily gotten over. We have as yet had no thorough test of the points mentioned. Next week we will take the train to Minnesota and Dakota, and stay there until we run against a blizzard. Then the real test of the system will come. If the traps can be kept clear so as to allow the condensation to run off, and the joints be kept from freezing with the thermometer 20 below zero, then we may begin to feel that we have made a step in the right direction. Unlike the system in use on the elevated roads in New York City, heat can be supplied to one car or one portion of a car while shut off from all other parts of the train; or, on the other hand, it can be shut off from one car on the train. In this particular it is very satisfactory. So far this demand for steam for heating has apparently no effect on the engine. It is claimed that it will take no more than the air-brake. If so, then it can readily be supplied. If the demand is too great for the engine we have another plan, and that is an iron car which will contain the boiler for the steam-heating apparatus. Plans for such a car have been prepared, and it will be built this summer. The car is to be entirely of iron. Nothing about it will be capable of ignition except the fuel it will contain. It will be about the length of a locomotive tender. One end will contain the boiler and the other the fuel and water-tank. Anthracite coal will be used, as it gives more heat in proportion to a given quantity. The car will be run next the engine and be in charge of an engineer. I don't see, however, how we are to get rid of the stoves for emergencies. As, for instance, when a car has been switched off for two or three hours to wait for another train, or when a train has been caught in a snowdrift. Stoves will have to be carried, with a good supply of kindling, for just such emergencies, but have no fire in them when a train is running."

"But is there not danger from the escaping steam in case of an accident?"

"None at all. The pressure is too low, and all the condensation passes off at once through the trap. If there was a break in one of the pipes, and you were standing a foot away, you would imagine you were enveloped in a cold fog —that is all. No, there is no danger from that source.

"But, as I said, we can tell nothing about the system until we have had a wrestle with a genuine northwest blizzard; and that we will try and find within the next few weeks."

In case it is found necessary to run a car for the steam heating apparatus, as proposed, it is probable that a dynamo will also be put in and the question of lighting cars by electricity be solved at one and the same time with steam heating. Mr. Gibbs expressed the opinion that with the oil now used, a 300 test, there was little danger from that source, but admitted the superiority of electricity if it could be arranged. The storage system now being experimented with East, he thought, would be a failure.

Pipe Unions.

Every man who has had charge of locomotives is ready to acknowledge the labor, annoyance and delay caused by the ordinary pipe union. The union most commonly used has a flat joint which is made steam or water-tight by means of a gasket, the latter generally of rubber. The life of this form of joint is short, and leakage often begins at the most inconvenient times, and when an engineer or machinest tries to stop the leak by screwing up the nut a little tighter, something often breaks, a new union has to be put in, considerable time is used over the job, and when it is finished there is nothing permanent about it. The flat joint iron union has many other mean attributes which are familiar to the men who are still wrestling with this means of connecting pipes, not the smallest of them being that the nuts of a given size are not interchangeable. Here is a representative case. The union of a blower pipe is reported leaking, and a machinist goes to put in a new gasket. In taking it apart he breaks the nut. To do the job, he then gets a new union, costing 10 cents, a new piece of pipe, costing 5 cents and a coupling, costing 6 cents. He puts in two hours over the job, at 30 cents an hour; total cost for the trifling repair, 71 cents. Trifling repairs of this kind are what render locomotives costly for running repairs.

These reflections occurred to me along with many reminiscences of the annoyance endured from poor pipe unions, as I examined a system of brass ball joint unions now in use on the Burlington, Cedar Rapids & Northern Railway. All unions of the same size are interchangeable, being made on a cabinet turret lathe with special tools, each part to a template or test size. All ½ inch or other size of nuts are exact duplicates of their kind, and the sleeve for screwing on to the pipe has the standard pipe thread of its size, no braying of collars to the pipe being allowed. Sizes of unions are made ranging from ⅛ inch to 1½ inch, and cover a range of pipe work from the small steam gauge to the injector check. When a union of this kind is once put in it is good without repairs till the pipe must be taken apart, and then there is the assurance that the nut of the union can be unscrewed without breaking something. The system of interchangeability not only reduces the stock that must be carried, but it provides a sure way of getting a union in an emergency. The union on the injector throttle will interchange with the union at the injector check; the union on the blower-pipe in the cab is precisely the same in every respect as the union of the same pipe in the smoke-box; the union of the cylinder oil pipe in the cab interchanges with that on the steam chest, and all the unions of a given size used in connection with the Westinghouse brake or other pipe attachments can be used indiscriminately. Not only are all unions interchangeable but any of its parts can be taken and will be found an exact fit. If a nut breaks or an accident happens to a sleeve, destroying the thread, the good piece has not to be thrown away, as in the case of iron unions. The portion of the union needing renewal is removed, and a new part substituted with the certainty that it will fit the good order part. When an engine is taken into the shop for repairs all pipe work can be taken apart without breakage, and with a little grinding the old ball-joints go together again and are as good as when new.

The system was worked out under the direction of Mr. Bushnell, by Mr. Allan McDuff, foreman of machinery, an excellent, clear-headed mechanic, who appreciates the advantage of doing all mechanical work on systematic methods.

A. S.

THE *Railway Age* has published in ordinary pica a very handsome copy of the Interstate Commerce Law in pamphlet form. The pica type was selected because the Interstate Commerce Law requires that all schedules shall be plainly printed in large type of at least the size of ordinary pica. The pamphlet is sold for 25 cents and is greatly in demand.

Communications.

Extension Smoke Boxes.

Editors National Car and Locomotive Builder:

Your notice in your last issue of a communication relating to extended smoke boxes, which, by reason of its injudicious tone and expressions, was not deemed by you proper for publication, prompts me to seek through your columns a statement of *the reason why* 36 to 44 extra inches of length in a locomotive smoke box attains the remarkable results which have been ascribed to it since its revival and adoption by the Baltimore & Ohio and Pennsylvania Railroads, some six years ago.

I am quite prepared to admit that engines whose smoke boxes have been extended, together with changes in their spark-arresting devices, stacks and exhaust nozzles, have thereafter shown a decidedly better (although far from perfect) performance in the matter of throwing fire and cinders. I can not, however, understand on what basis this result should be, as it has been, credited to the extended smoke box, and why the other modifications of construction under which it has been attained should be totally ignored. Briefly, my contention is that their improved performance has been attained not by reason of, but utterly irrespective of, the extended smoke box, and in despite of its obvious disadvantages, and that it has had, in fact, no more share in the result than the coat of red paint on the stack which sometimes accompanies the alteration.

It is scarcely fair in the first place to compare an engine having a diamond stack (the most defective and inefficient form of spark-arresting stack), low nozzle and no deflector or brick arch, with one provided with an open stack, a high nozzle of greater diameter, a spark arrester and deflector in smoke box and a brick arch, but even after making such a comparison to ascribe the advantage of the appliances last named to an extended smoke box, of which they are entirely independent, and without which, as shown by practice, they will operate just as well as with it, does not appear to be warranted, either *prima facie* or by any recognized mechanical law or principle bearing on the subject.

As originally proposed by its designer, John Thompson, in 1860, the extended smoke box was to act as a spark *arrester* without any spark-arresting devices whatever, on the theory that the sparks would be carried forward and deposited in the front end. This theory is fallacious on its face, and a smoke box deflector and netting, which are a necessity to its operation, were very soon adopted by those who essayed its use. These appliances, in conjunction with an open stack, larger nozzles, a brick arch in the fire box, and more intelligent and careful firing, are unquestionably advantageous, both in theory and practice, but they should be awarded the credit which is due to them and not be subordinated to a construction with which they have no necessary relation, and which exists only by reason of the fact that they have rendered it practicable.

A communication which appeared in your columns some time last year from a New England master mechanic, and which I have not now at hand, states that the writer was substituting, satisfactorily, 18 inch extensions for 30 inch, and I have personal knowledge of two roads upon which the spark-arresting appliances above referred to have performed equally well with smoke boxes of the ordinary dimensions and with short extensions, as when used with extended smoke boxes of the type now in vogue. It is possible that there may be engines of antiquated construction whose fire-boxes are so inadequate to the service that a large proportion of their fuel is lifted from the fire by the exhaust and drawn through the tubes, but it can scarcely be maintained that in present practice combustion is so defective as to need or even justify a receptacle for unconsumed fuel of the dimensions of an ordinary extended smoke box. The extended smoke box is incapable of performing any function as a spark *arrester*, and as a spark *receptacle* its disadvantages are manifest. A small separate spark chamber under the front end, as in the Mitchell, Hunter and other constructions, will contain all the unconsumed fuel discharged from a fire-box which is doing anything like normal or economical duty, and such a receptacle seems in every respect more desirable than a heavy, expensive and ungainly extension of the smoke box. J. SNOWDEN BELL.

PITTSBURGH, Pa., Feb. 7, 1887.

Locomotive Performance in Texas.

Editors National Car and Locomotive Builder:

The record of locomotive performance as given by your Jacksonville, Fla., correspondent in your last issue, is one with which mine will not compare. I wish to say, however, what I should have said in my previous communication, that the fuel used on our road is "Loblolly" pine, and that such a thing as fat pine is unknown to enginemen on our road. We pay the same price for our pine that your correspondent does for his, and if he will send me a cord of fat pine, such as he used, I will agree to run my Dickson engine from Houston to Shreveport, 232 miles, and pulling three coaches, with one cord only of his kind of pine. Fat pine is far superior to coal, as any engineer knows who has used both. I think it best to say this, as it is probable that no road, north or east or west, has had much experience with fat pine, nor do I think your Florida correspondent has had any "Loblolly" pine to contend with, or he could not make such good mileage.

I still challenge those using the same quality of fuel to show a better record than mine. Our passenger engines pull three coaches over gradients of 70 feet to the mile, and our freight trains consist of from 14 to 16 cars. Our statement for the fiscal year ending July 11, 1886, shows that during that time we made 309,137 miles, using 5,925 cords of wood and 281½ tons of coal. Our total cost for repairs, stores, fuel, superintendence, pumping, repairs of tanks, stock killed, engineers and firemen and every thing connected with the running of an engine was $19\frac{3}{10}$ cents per mile. The amount paid for stock was $1,517, and for pumping and keeping up water stations $5,434. If we deduct these two amounts from the total cost we will have $17\frac{1}{10}$ cents per mile as the cost of running an engine, of which amount 5¾ cents is for repairs, both labor and material, which includes both the running and extraordinary repairs to all engines. During this time we had no wheel lathe, and were compelled to pay $100 for turning our eight-wheel tires and $5 for transfer, and our moguls cost $130 for turning and $10 for transfer. Now, however, we have a wheel lathe, and although it is an inferior one, yet it does not cost us more than $40 for our mogul engines and $30 for our eight-wheeled engines. We have no wheel press, our tools consisting of two little lathes, one 18-inch and the other 10-inch swing, one large drill press and one small one and one bolt cutter. E. A. CAMPBELL,

Supt. M. P. & M., H., E. & W. T. Ry.

HOUSTON, Tex., Feb., 1887.

Our Craftsmen.

Editors National Car and Locomotive Builder:

The United States was the last of the industrial nations to found industrial institutions on a liberal scale, but now that we have entered upon the work we are proceeding in it with our usual activity.

The Cooper Institute, New York; the Institute of Technology, Boston; the Worcester Institute of Industrial Science; the Manual Training School, St. Louis; the Chicago Manual Training School; the Stevens Institute of Technology, Hoboken, N. J., and many others of the same high character attest the interest bestowed in this direction.

Regarding manual training in public schools, although some cities have entered actually upon the experiment, still among educators generally it is an open question whether manual training should be introduced in our public schools. The subject was discussed at the meeting of the National Educational Association at Madison, Wis., in July, 1884. The need of special schools of "Mechanical Arts" was freely admitted, but as to whether manual training should become a part of the public school system, views differed widely, but, says the report of the commission, with a general agreement against it, we have often seen such statements as the following: "Industrial education in manual training must be introduced in our system of public schools." Where there is such divergent opinion, as well as the great importance of the subject, and the paramount importance of all that touches education, shows that the relation of the state to this subject, the question of manual training in our public schools, needs wide and careful discussion by experienced, thoughtful and learned educators.

It is claimed that the Kindergarten and manual training are one in principle, and should be one in practice. I fail to see the oneness, and it is my conclusion, based on long and careful investigation, that manual training ought not to be incorporated with either public or private education in the primary grades.

An industrial college is, of necessity, an expensive institution. The one at Worcester, for instance, although benevolent men have bestowed upon it liberal gifts, I am informed that few students are able to get along with less than $500 per year, and during at least 42 weeks of the year the students can not earn money without falling behind in their classes. Even in cases where they receive their tuition free, from a poor man's point of view, it takes quite a considerable sum per annum; as every one knows, tuition is but a small fraction of the student's expenses.

Would that all boys intended to follow mechanical pursuits could be granted such advantages as are offered by our best mechanical schools. To students with the proper natural aptitude for science and the mechanical arts, the advantages there derived are of the most valuable character. The aim of the manual training school is the making of men who will know how to use both books and tools; to train the mechanical aptitude of the eye and hand and intellect, and to produce men who can put brains into their work and think and plan and invent. To those of us who are inclined to consider manual training for boys under 15 years of age as just so much child's play; and who also see that the manual training school is out of the reach of a great majority of our boys; the question is pressed on us, where are our future mechanics to receive their training? Where have they done so before, and where ought to be the best place of all? In the workshop itself. And it augurs well for the future prosperity of the country to find so much interest being taken on all sides, to give our armies of industry instruction and training in the higher arts of their warfare.

I inclose circular: General Order No. 39, just issued by the General Superintendent of the Union Pacific Railway Company, S. T. Smith. It is issued with a view of securing a higher standing of excellence in the company's service, and it reflects great credit on the management, and results will, no doubt, be of a splendid and far reaching nature, in the way of producing men who will not be machines, but mechanics. This circular has a wider and more far-reaching bearing than might at first sight be noticed. It means in future to all who are to be prepared to enter the ranks of Union Pacific apprenticeship "Compulsory Education."

To every boy with mechanical tastes in all the States and Territories tributary to this great system, this circular must come as a morning star, calling them to "Wake up, wake up!" The only objection that has been raised to this circular is that the examination is too rigid in nature. We are justly proud of our free schools, and what is wanted here, and now, is "Compulsory Education," so that not only every child who expects to become an apprentice in any of the Union Pacific shops, but every child in this much favored Republic, must be educated. J. W.

[The scope of General Order 39 was outlined in our Shop Notes of January, under the heading of "Apprenticeship System."—EDS. N. C. & L. B.]

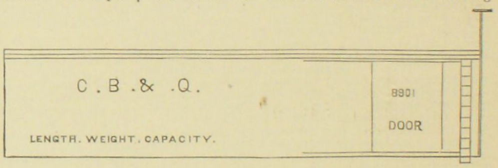
Freight Car Doors.

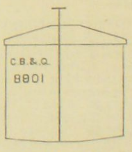
Editors National Car and Locomotive Builder:

I wish to submit, for the consideration of car builders, through the medium of your paper, a few ideas in reference to freight car construction.

Box cars at present are invariably built having doors in the middle or center of the sides, and also in most cases with end doors. Science teaches that the door of a car ought to be toward the right hand side, as in the entrance to a properly constructed house. Having the cars constructed with the doors where they ought to be would do away with the necessity for end doors, and cars could then be utilized for carrying bar iron or timber, as well as merchandise, the present construction being a serious matter for those who have occasion to handle bar iron or lumber, especially when the end doors are nailed or screwed up, as they very frequently are.

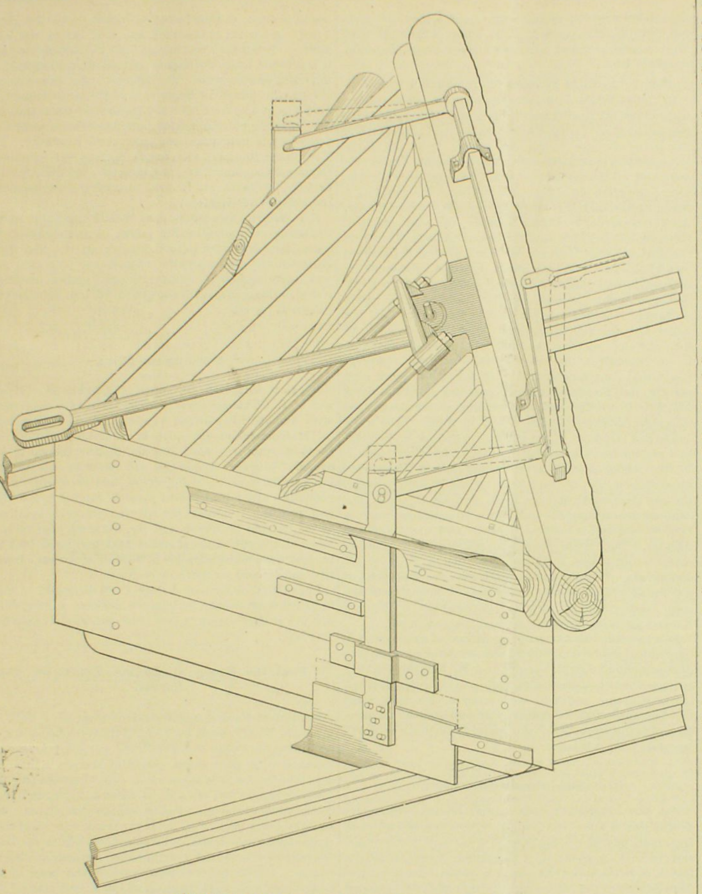
The door in the middle of the side seems to have suggested the idea that a freight car is a double car, and led those who have charge of the lettering, the initials and names of the owning companies, and the numbering the cars, into serious blunders. With this note I enclose a sketch showing how the proper construction would affect the lettering and numbering.





Now, I maintain that to have the doors where they ought to be, and the car lettered as it should be, would tend towards an uniformity of construction of box-cars, would insure an easier handling for brakemen, a better understanding for those who take notes of the initials, numbers, weight, etc., and to a quicker method of loading and unloading. M. A. G.

MR. WM. MCWOOD, the superintendent of the car department of the Grand Trunk Railway, is building at the Montreal shops a number of passenger cars to be run in through trains, without change, between Montreal and Chicago. Some of them are combination smoking and non-smoking, the dividing partitions being in the center. The inside finish is in plain light-colored woods. The outside is a maroon color like that of the standard coaches of the Pennsylvania Railroad. The cars are furnished with Forney seats. In the combination cars a new departure has been taken in the location of the Baker heater. Instead of being at one end, it is placed midway between the ends, and inclosed in a zinc box or casing so secured as to prevent the fire from escaping in case of accident. Its central location also renders it less liable to be fractured in a telescoping collision. The cars are mounted on the standard trucks of the road, with 41-inch wheels.



SNOW FLANGER—CENTRAL IOWA RAILROAD.

The annexed engraving gives a perspective view of an ice and snow flanger used on the pilots of the locomotives of the Central Iowa Railroad. The apparatus was designed by Mr. John Player, the able and ingenious master mechanic of the road, and combines the unusual qualities of being very cheap and efficient. The whole thing can be so easily understood from the engraving that no description is necessary.

The Leslie Rotary Steam Snow Plow.

This device, which was illustrated in the CAR-BUILDER for October, 1884, is reported to be doing remarkably effective work on the Pacific slope this winter. The Union Pacific Railroad Company engaged the services of the machine early in the winter, and sent it out to work on the Oregon Short Line, which has always been very troublesome to keep open, the snow-fall in the district being very heavy. No difficulty was experienced in keeping the road open with the Leslie plow. Several changes were made in the machine since last winter, experience in the snow having developed weak points. It has now no independent cutting wheel in front, the cutters being attached to the fan which throws out the snow. Since this change was made, the machine is reported to be capable of working its way through a heavy snow drift at a speed of twenty miles an hour. The Union Pacific people are so well satisfied with the working of the machine that they are negotiating to have seven or eight new ones built for next winter's work.

Car for Supplying Heat and Light.

The Northern Pacific Railroad people do not appear to think the locomotives hauling their through trains can spare the steam required to heat the cars, for they have begun to build an iron car to carry a steam boiler and machinery for heating and lighting the whole train. Mr. Oakes, the general manager, and Mr. Cushing, the superintendent of motive power, both agree, we believe, that a new system of safe heating ought to embrace a system of safe lighting of cars in a train. The car when ready will be placed behind a locomotive and a train attached long enough for making thorough tests, which will be carried out before the arrangement is put in regular service. Several other northwestern railroad companies are watching this experiment with eager interest, and on its results will depend their action in the matter of improved methods of heating and lighting their cars.

If this experiment results in success the problem of heating and lighting trains without danger to the lives of the passengers may be solved. The plan seems practicable, and the railroad company deserves credit for the promptness with which it has sought a remedy for a very deplorable evil. It is absurd to suppose that in these days of advanced science some substitute for stoves and burning fluid can not be found for heating and lighting railroad cars. All that is needed is the resolute will which has suggested the present trial, and which, it is to be hoped, will accomplish a triumph.

Automatic Stove-Fire Extinguisher.

Mr. S. H. Harrington, mechanical engineer of the Pittsburgh, Cincinnati & St. Louis Railroad, has been working for some time by the directien of Mr. E B. Wall, superintendent of motive power, striving to devise means of extinguishing the car stove in case of collision or wreck. He has lately produced an apparatus which appears to work satisfactorily, and it has been subjected to very severe tests, similar to the conditions present in a bad accident. The method of preventing fires is exceedingly simple and ingenious. Each truck on the train is provided with what may be called a derailment brake. When a wheel leaves the track, the derailment brake immediately sets the brakes on the whole train, and allows the air from the air-brake train-pipe on the car derailed to operate a chemical fire extinguisher. This chemical fire extinguisher is connected with the stoves, and discharges the whole of its contents into the fire-pots of the stoves.

The device has been successfully experimented with privately, and a public trial will be given in a short time. The derailment brake in itself is an invention of great importance. The Westinghouse automatic air brake, as now used, can be operated in three ways: By the engineer's valve in the engine, by the conductor's valve in the car, or by separation of the hose couplings, either in case of accident or when they are intentionally uncoupled by hand. The derailment brake gives the Westinghouse brake a new automatic feature and causes the immediate application of the brake as soon as a car leaves the track without waiting for the engineer, or for the couplers to become separated. This result will be seen on reflection to be very important, as it prevents that class of accidents where a car leaves the rails on an embackment or bridge approach and runs along some distance without attracting the engineer's attention until it is too late to apply the brake, and the car goes over the embankment or off the bridge.

The derailment device consists of two short pieces of pipe joined together in the form of a "T," suspended from the equalizer bar above the rail between the wheels. When, for any reason, the cross-bar of the "T" strikes the rail, as when a wheel leaves the track or an axle is broken, the upright arm of the "T" opens an escape in the air-brake train-pipe. This escapement destroys the equilibrium in the train-pipe, and applies the brake. The further utilization of the escaped air to operate a fire extinguisher is extremely clever. The fire extinguisher consists of a vessel holding water charged with a preparation of soda; on one side it is connected with the stove, and on the other to the derailment brake by a pipe. In this pipe there is a siphon containing sulphuric acid, and when the air from the derailment brake passes through this siphon it forces the sulphuric acid into the main vessel of the extinguisher, filling the stove and destroying the fire. A fire extinguisher compound is used, instead of plain water, depending upon gravity, so that the device will operate with certainty, no matter in what position the car might be thrown.

A separate hose attachment to the extinguisher gives an ndependent means for putting out incipient fires that might at any time occur in the car.

The whole arrangement is entirely new, and will attract a great deal of attention as being a feasible solution of the problem of extinguishing fires in railroad accidents.

A High-Speed Locomotive.

The Rhode Island Locomotive Works have recently built for the New York, Providence & Boston road a locomotive specially designed to haul a train of eight cars, four of them being Pullmans, 62.5 miles in 62.5 minutes, including two starts and two stops. The train will weigh about 230 tons, and will be the fastest train run on any railroad, besides being the heaviest train we know of run at a speed above 45 miles an hour. The engine, which is of the eight wheel type, has cylinders 18 × 24 inches, and driving wheels 72 inches diameter, kept down by an adhesive weight of 96,000 pounds, 24,000 pounds being on the engine truck. The boiler is of the wagon top variety, designed for the burning of anthracite coal, and is 54 inches diameter at the smallest ring, has 218 tubes 2 inches diameter, and a fire-box that provides 165¼ square feet of the heating surface. Otis steel is used for the entire boiler and fire-box, the shell being ½ inch thick, designed to carry a working pressure of 180 pounds to the square inch, the total heating surface of the boiler, so far as we can make it out, being about 1,300 square feet. The conspicuous feature about this locomotive is the great weight upon the driving wheels, which will enable the engine to force the train into speed quickly without trouble from slipping. The steam passages are notably large, and will probably enable 165 pounds of cylinder pressure to be utilized in starting, giving a force of 17,800 pounds for turning the wheels and a co-efficient of adhesion of 5.

The task the engine, which is known as the "J. W. Miller," is designed to perform is an extremely difficult one; but Mr. Joseph Lythgoe, superintendent of the Rhode Island works, in whose judgment we have great confidence, is reported to have expressed assurance that the engine would do the work required. Our experience with hard coal burning locomotives has been rather limited, but, judging from what we have seen of the performance of the Pennsylvania high-speed engines of the class K type, we should fear that the "J. W. Miller" will prove deficient in heating surface; that is, if our estimate of the total heating surface is correct.

DURING a visit to Marshalltown, Iowa, a short time ago, we found Mr. John Player, master mechanic of the Central Iowa Railroad, using a scale remover in the boilers of his locomotives, which was doing good service in counteracting the bad effects of the hard water they have to use. In the course of extended experience with numerous forms of scale removers, we had come to the conclusion that compounds which removed scale acted injuriously on the metal of the boiler, and we advised Mr. Player to put a piece of zinc in a solution of the boiler compound, place it in a warm place and wait for developments. He did so, and kept the zinc in soak on the top of his stationary engine boiler for a week, but the metal showed not the least trace of corrosive action. We have since learned that the compound is made from petroleum, and is a patented composition owned by the Pittsburgh Scale Resolvent Co.

Engineering and Shop Notes.

ILLINOIS CENTRAL RAILROAD SHOPS.

The heavy freight business that has been moved for months past has thrown a large amount of repair work into these shops, and they are working a large force of men. Apart from the run of repairs, they have just completed ten new mogul locomotives and are now working on four new suburban engines. The moguls are fine looking engines, with cylinders 18 × 24 inches, shell of boiler 56 inches diameter and containing 211 flues 2 inches diameter. In working order these engines weigh 48 tons, which is very well distributed for adhesion. They are capable of handling any train, so far as weight is concerned, that the company care to run, and the drivers having centers 56 inches diameter there is no difficulty in making the fastest speed now called for, even with the growing practice of running fast through freight trains at an average speed of 25 miles an hour.

The suburban engines are of the type designed for this services by the late Wm. S. Hudson, of the Rogers Locomotive Works, and have engine and tender carried on the same frame, the hind portion being supported by a four wheel truck, while the main weight is carried by two pairs of driving-wheels coupled, placed between the fire-box and cylinders. A swing pony truck is employed to carry a small proportion of the weight in the front end. These engines have cylinders 16 × 22 inches, the driving-wheel centers are 56 inches diameter, and the boiler shell is 50 inches diameter at smallest ring. In working order the engines weigh 54 tons. They have an admirable record for the efficient way they handle the heavy fast suburban traffic of the road.

Three years ago Mr. Schlacks covered the boiler of one of his suburban engines with the Goodell Boiler Lagging, which gave so much satisfaction that he is now having ten more boilers covered in the same way. The material employed is a mixture of lamp-black and manilla fiber. The non conducting qualities of lamp-black are well known, and the composition made of it and the fibrous material that holds the mass together appears to make a boiler covering well calculated to prevent radiation of heat.

In the car shops they have just completed a fine new chair car, and are now engaged building 500 freight and stock cars, each of them being 35 feet long over sills and capable of carrying 20 tons. All the cars have 36-inch cast-iron wheels and heavy axles with journals 4 × 8 inches. The stock cars are built with outside stake pockets, a plan which the officers say greatly facilitates repairs.

PAN HANDLE RAILROAD OFFICES.

Mr. E. B. Wall, superintendent of motive power of the Chicago, St. Louis & Pittsburgh railroad, has in his office at Columbus a board for showing the condition of the rolling stock under his charge, which is the most perfect arrangement of the kind I have seen. For each engine and car there are four pegs for holding tickets that indicate number, class, service and condition of engine or car. The condition is indicated by colored tickets and has seven grades:

1. Is light purple, and means in good condition.
2. Is light red, and means that the engine is in service, but requires repairs of class 4 to 5.
3. Is dark red, and signifies that the engine is still in service, but requires repairs of class 1, 2 or 3.
4. Light red with hole in the middle, means that the engine is in the shop getting repairs of class 4 to 5.
5. Dark red with hole in the middle, tells that the engine is in the shop for repairs, class 1, 2 or 3.
6. Is blue, and means that the number is vacant.
7. Blue with hole in middle, indicates that the engine is rebuilding.

The different classes of repairs have the following significance:

1. New boiler and general repair to machinery. Time, 90 days, cost, $4,000.
2. New fire-box and general repair to machinery. Time, 75 days, cost, $3,800.
3. Re-setting of tubes and general repair to machinery. Time, 40 days, cost, $1,500.
4. Re-setting of tubes, turning of tires and slight repairs to machinery. Time, 25 days, cost, $500.
5. Slight repairs, such as facing valves, etc. Time, 5 days, cost, $200.

The condition and requirements of cars are recorded on a similar plan. By looking at the boards Mr. Wall can study out quickly the condition of all the rolling stock, the whole equipment presenting itself like a map. The preponderance of any color is readily observed, and the tendency it indicates is not likely to be overlooked.

In the drawing office, Mr. S. H. Harrington, the chief draftsman, has got all branches of his work very systematically arranged. By the plan for indexing blue prints and tracings which is followed, any individual print or tracing can be found within one minute, a notable feat considering the fact that the office contains over 6,000 different drawings. The prints and tracings are kept in cabinet drawers marked so that the record in a finely-arranged index book shall indicate exactly where every print and tracing is to be found. There is a place for everything and everything is in its place, and the rules are rigidly enforced. No drawings are kept. The drawings are all made on manilla paper and traced, the tracing becoming the record. The office is bristling with ingenious devices and convenient contrivances that tend to reduce labor.

NEW FOUNDRY AT PITTSBURGH LOCOMOTIVE WORKS.

Mr. D. A. Wightman, superintendent of these works, was for several years collecting data and cogitating on the requirements of a perfect iron foundry, and the result of his labors is now in running order. It is the finest arranged and most perfectly equipped foundry I have ever seen, and all the mechanical men I have talked with who visited the place are of the same opinion. The building is 236 × 80 feet, and the height of posts is 28 feet 4 inches. An iron truss roof covers the foundry, and while ample in strength, appears light, and the beams do little to obstruct the light admitted from above. The building is traversed by a 15-ton Yale & Towne crane, operated as desired by connection with the machine shop shafting, or by a Westinghouse engine located in the foundry. The power is highly speeded up, so that the ladles of hot metal are quickly transported from the cupolas to the various pouring points. A molding machine is in operation in one corner of the building and works very satisfactorily. It turns out work very rapidly, and for a great many purposes does the work just as well as a first-class molder, and, so far as can yet be noticed, displays no disposition to strike. The work put in and taken out of the molding machine is handled by a pneumatic cylinder that operates over a distance of 70 feet, being carried by traveling crane. There are three cupolas, two of them being of the Colliau pattern. Located close to the cupolas is an elevator of three tons capacity for raising coke and iron. The cupola house is 41 × 35 feet, and is built at the side and middle of the foundry. The pattern shop, with chipping and cleaning rooms below, is also a separate building of 70 × 80 feet dimensions. The core rooms are below the floor level of the foundry and occupy a space 41 × 90 feet, and the core ovens, three in number, measure 24 × 13 feet. Natural gas is employed for heating the core ovens.

As a rule, the foundry is not an object of pride about a mechanical establishment, and the superintendent or proprietor seldom takes his visitors over it; but the foundry of these works is a decided exception to the rule. It is the lion of the place, and will well repay a visit from those who can appreciate the merits of a well ordered foundry. To watch the working of the molding machine is worth traveling a long distance. A. S.

The First Rogers Locomotive.

The first locomotive built at the Rogers Locomotive Works was a six-wheel engine, with a four-wheel truck and single pair of driving wheels in front of the fire-box, and the deck overhanging. The cylinders were inside the frame, so that crank axles had to be used. The eccentrics were outside of the frame, and the eccentric rods extended back to rocking shafts, which were placed under the deck. The smoke-stack had a cone in the top, which was then a novelty, and a bonnet top was used to prevent the emission of sparks. The engine had hollow cast-iron driving wheels, and a counterbalance weight was employed to compensate for the weight of crank and main rod, all of which were novelties at that time. The engine was finished in October, 1837, and was intended for the New Jersey Railroad and Transportation Company, the gauge of which was 4 feet 10 inches. For some reason the company that the engine was built for did not take her, and she was sold to the Mad River Railroad of Ohio, and was named the "Sandusky." The engine exerted, probably, more influence on railroads than any locomotive ever built.

The Mad River Railroad was chartered in 1832, the intention being to make rapid connection between Lake Erie and the Ohio River by the way of Sandusky, Springfield and Cincinnati. Financial difficulties prevented the company doing anything towards building for several years, but in 1838 sufficient progress had been made to lay down several miles of track. This was the first railroad begun in Ohio, and the intention was to make the gauge 5 feet. A portion of the track was laid before the locomotive "Sandusky" was brought to its destination, and it was found when the engine arrived that the gauge of the track was too wide. The difficulty was overcome by closing the gauge of track two inches, and when the road was in operation the Legislature of Ohio passed a law requiring all railroads in that State to be built to a gauge of 4 feet 10 inches, the same as the Sandusky. The Mad River Railroad afterwards became the Sandusky, Dayton & Cincinnati, and still later the Columbus, Springfield & Cincinnati. It is now part of the Indianapolis, Bloomington & Western.

Mr. William Swanston, now master mechanic of the Pittsburgh, Cincinnati & St. Louis, at Indianapolis, did some of his first work in this country on the Mad River Railroad, and remembers the "Sandusky" very well. She was a very successful locomotive, and pulled passenger trains for many years till she got to be too light for the weight of trains.

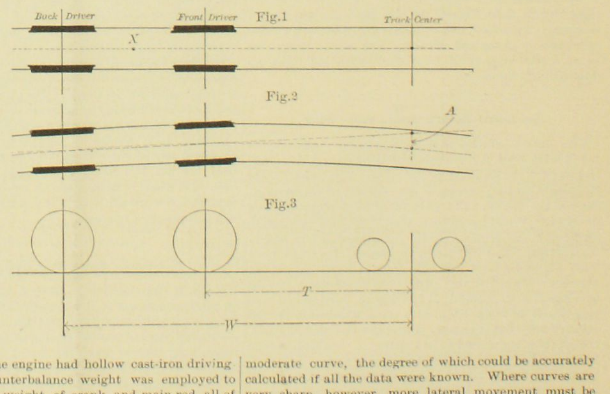
Flooding the Stove.

Mr. L. R. Witherell, Davenport, Ia., writes us: "Myself and I. J. Clevenger have invented a device to do away with cremation in railroad wrecks. I put a little mechanical attachment on any stove at an absolute cost of from $3 to $5 that will flood the fire in an accident in one second. It is very simple and will never be operated unless a collision or tip over occurs, and then without the possibility of a failure it will squelch the fire in less than two seconds. It matters not whether the stove is upright or on its side or wrong end up, the work is perfect. I know all the objections of steam heat, and know that the present want is the adoption of a safety stove attachment that can be used on cars now on hand.

I have no time for long letters, I am no crank. I have invented some twenty well known devices, among which are the rubber stamp, spiral door spring, Eads ship railway, etc.

To Find the Swing of Engine Truck for Sharp Curves.

Mr. Robert Hardie, superintendent of the New York Locomotive Works, sends us the formula given below for determining the swing of engine truck necessary to enable a locomotive to pass sharp curves of a given radius. He says that the formula takes no account of lateral play, 1st, between flanges and rail; 2d, of axles in boxes, and 3d, of truck center in the pin. Let us suppose an engine on a straight track as in Fig. 1. If the truck were rigid there would be some lateral movement by which the truck wheels could be moved to right or left without moving the engine. Add to that the distance which the head of the engine can be moved to take up all the lateral play of the drivers. That would be virtually about a pivot midway between the drivers, as at X. It is obvious that all this play would permit an engine with a rigid truck to pass around a moderate curve, the degree of which could be accurately calculated if all the data were known. Where curves are very sharp, however, more lateral movement must be given, and this is usually provided by means of a swing center truck. The usual method of finding the necessary swing has been to lay out curves with wooden patterns on produced chords, and have the exact distance measured as in Fig. 2, all other lateral play being allowed for clearance.



By the formula shown in connection with Fig. 3, I get the required distance A without employing models and chords. The accuracy of the method has been verified repeatedly by actual measurements.

Let W = distance from back driver to center pin.
T = " " front " " "
D = diameter of curve (twice the radius).
O = offset or distance A.

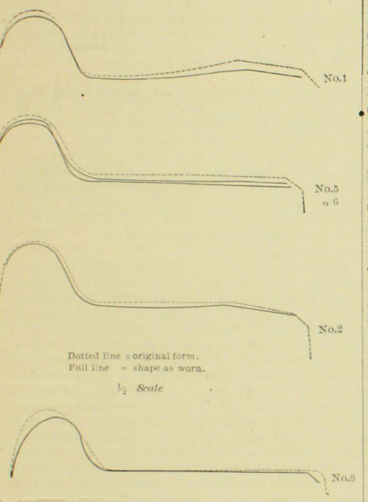
$$\text{then } \frac{WT}{D} = O.$$

Tire Dressing Shoe.

The annexed table and diagrams show the wear of tires that are running under the application of the Meehan tire dressing shoe. In writing to us about the matter, Mr. Meehan says : "I think the chart is self-explanatory. All the diagrams are highly satisfactory, except No. 2, in which case I do not think the engineer applied the brakes regularly."

RECORD OF WEAR OF TIRES UNDER APPLICATION OF THE MEEHAN TIRE DRESSING SHOE, ON THE CINCINNATI, NEW ORLEANS & TEXAS PACIFIC RAILWAY.

Coach or engine.	Size of wheel. inches.	Kind of Tire.	No. of shoes.	Weight of shoes. lbs	Steel in all. lbs.	Date of application.	Date of observation.	Total miles made.	Decrease in wt. of shoes. lbs.	Decrease in wt. of one shoe. lbs.
E. 48.	52	Midvale.	4	262	17	Sept. 10, '86.	Oct. 27, '86.	5,292	38	9½
C. 118.	42	Washburn and	8	380	28	Oct. 7, '86.	Dec. 5, '86.	21,140	44	5½
C. 118.	42	Wednesbury.	8	380	28	Oct. 7, '86.	Feb. 2, '87.	43,170	114	14½
E. 79.	68	Standard.	4	316	22	Oct. 21, '86.	Dec. 31, '86.	11,744	33	8¼
E. 1.	68	Krupp.	4	316	22	Nov. 26, '86.	....	......	....	...
C. 128.	42	Allen.	8	380	28	Nov. 5, '86.	Feb. 2, '87.	20,185	96	12



A Good Locomotive.

The following is an exhaustive outline of an address delivered by Mr. Angus Sinclair, under the auspices of the B., C. R. & N. Mutual Improvement Class, Monday night:

The object of the steam engine is to transform the energy of coal into mechanical work. The best steam engine and consequently the best locomotive is that which will do the greatest amount of work with the least possible quantity of fuel and the [illegible] repairs. Designers of locomotive [illegible] boiler Construction, and difficulties to contend with [illegible] team Engineering. Th[illegible]rs of stationary and marine eng[illegible] Boilers is very [illegible]culties, the locomotive compares very [illegible] any prime motor in popular use. But at best the locomotive is a comparatively defective machine. It only uses about five per cent. of the energy of the coal consumed. The margin of work in comparison to waste being so very small, great efforts have been made to produce a more efficient means of utilizing the energy in coal. This has brought the talk of electrical motors to the front, and many people think that electricity is the motive power of the future. But so far as we can see, there is little prospect of the hope being soon realized. Electricity as popularly used is not a prime motor. It has to be generated in a secondary way by machines driven by steam engines. Scientific men think that it will yet be possible to obtain electricity direct from the energy of coal, and if that dream be ever realized the days of the steam engine will then be numbered. Some great inventions have been developed so slowly that it seems possible electricity may be yet obtained direct from coal. It took 2,000 years to develop the steam engine and make it a practical machine after the force of steam was discovered, and it may be possible that electricity will be developed in shorter time. Steam was developed under the pressure of necessity. The demand for better means for raising water than animal power afforded, set the philosophers of the seventeenth and eighteenth centuries struggling to apply steam to useful purposes. They knew the power that could be obtained from steam, but it seemed like a great giant which no man could handle until an unlettered mechanic, Thomas Newcomen, attacked the problem and applied the steam through a piston to a train of mechanism, and produced the germ of the steam engine. The world calls James Watts the inventor of the steam engine, but he was only its improver, the same as was Oliver Evans of Delaware, in the United States, who improved on Newcomen's engine and produced the high-speed, high-pressure steam engine of which the locomotive is the highest type, about the time Watts was improving the Newcemen engine by applying a separate condenser.

The locomotive was first developed from the high pressure engine in England, through the necessity for transporting coal to the shipping stations, and was gradually improved by various mechanics and inventors. One of the first difficulties encountered in developing the locomotive was the mistaken belief that the wheels would slip on rails very readily without moving the engine forward. When the laws of friction became better understood among mechanics, it was found there was no difficulty from this cause if the cylinder were proportionate to the weight of the drivers. Mr. Sinclair gave some illustrations of friction with a sliding block and showed that the co-efficient of friction was constant, depending upon pressure. He showed that the power required to slip drive-wheels of a locomotive depended on the weight resting upon the wheels. If the cylinder capacity was too great for the adhesion the engine would be given to slipping, and calculations were made showing how this could be regulated. He said a conspicuous feature about a good locomotive was that the cylinder capacity was adjusted to agree with the weight of the driving wheels, the boilers being made large enough to supply sufficient steam to the cylinders without forcing. Numerous illustrations were given of proportions of boiler, cylinders and weight that gave the best results in actual service.

Phenomena connected with combustion were then taken up and a number of experiments given by fusing steel in oxygen, potassium in water, etc., to illustrate combustion. He proceeded to show that the laws of combustion operating in the experiments, regulated combustion in the firebox of locomotives, and that if these laws were not followed and regarded, waste of fuel would ensue. He insisted that it was the duty of locomotive engineers and firemen to study the laws of combustion and apply them to their work, and that a man was not master of his business unless he understood the principles regulating his business. Detailed remarks were made about the practice of firing and about the quantity of air necessary under various conditions of coal burning. In every case he made out that ignorance and carelessness produced waste of valuable fuel, and that railroads ought to have no use for men who did not care to make themselves proficient in their calling.

The generation and use of steam was next taken up, and Mr. Sinclair dwelt at considerable length on the space occupied by steam at various pressures, its temperature and capacity for doing work. He followed water from the temperature of melting ice till it was evaporated into steam at ordinary boiler pressure, showing the amount of heat expended in the operation. Reversing the journey, he traced the steam backward from the boiler to the cylinder, estimated the amount of work usually taken out by expansion and demonstrated the cause of the small measure of heat economy possible with a steam engine.

The lecture was illustrated by a large drawing of a locomotive and by sketches made on a blackboard. In conclusion, the speaker urged upon the young men composing the B., C. R. & N. mutual improvement class the necessity for acquiring a knowledge of the principles of engineering if they desired to rise above the position of a mechanic. The lecture was listened to very attentively by a large and critical audience, and at the conclusion the speaker was heartily cheered and overwhelmed with questions.—*Cedar Rapids Gazette.*

Freight Train Brakes.

A meeting of the Committee of the Master Car-Builders' Association on freight train brakes was held at the Hotel Anderson, Pittsburgh, on the 9th inst. The meeting, as previously announced, was held to determine the rules and conditions governing the brake tests to be held at Burlington, Ia., prior to the Master Car-Builders' convention in June next. A joint meeting was then held of the members of the committee present and the representatives of the various brake companies. The rules proposed by the committee were submitted seriatim to the meeting and were fully discussed and finally agreed upon. The following members of the committee of the Master Car-Builders' Association were present: G. W. Rhodes, Chairman; J. S. Lentz and D. H. Neale. The following representatives of the different brake companies that propose taking part in the tests were present: American Brake Co., Geo. H. Poor; Carpenter Air Brake and Carpenter Electric Brake, Thomas Prosser, Jr.; Eames Vacuum Brake Co., Jas. H. Slade and N. W. Howson; Hanscom Automatic Air Brake, W. W. Hanscom; Park Electric Brake, H. S Park and W. Sherman; Rote Brake Co., C. F. Harding; Waldemar Electric Brake Co., L. W. Goss; Westinghouse Brake Co., T. W. Welsh, S. H. Sprague, Levi W. Close and F. Moore; Widdifield & Button Brake Co., W. D. Widdifield; Ward Automatic Brake, W. H. Ward.

The following is a list of the tests to be made at the trials:

GENERAL TESTS.

1. Fifty empty car trains making 4 emergency stops; first, 20 miles per hour on a level; second, 40 miles per hour on a level; third, 20 miles per hour on 53-foot grade; fourth, 40 miles per hour on same grade.

2. Fifty mixed car trains, two-thirds of the cars loaded, one-third empty, 75 per cent. of the latter being in front half train; first, second and third stops as above, fourth stop on grade at 30 miles per hour.

3. Fifty mixed car train with hand brakes and engine and tender automatic brakes; four emergency stops; first on a level at 20 miles per hour; second, at 30 miles per hour on level; third, at 20 miles per hour on 53-foot grade; and fourth at 30 miles per hour on same grade.

4. Train of 50 mixed cars to be let down a 53-foot grade 3 miles long; speed 20 miles per hour at top of grade to be reduced to 15 miles per hour as soon as practicable and maintained without material variation to the foot of the grade.

5. One or more runs over the course to be made with trains having brake shoes ½ to ¾ in. off the wheels before the brakes are applied.

6. Fifty mixed car trains; tests on the level; trains to be broken into two or more unequal parts, speed 30 and 20 miles per hour; after the train is broken any assistance will be rendered only by a brakeman, who shall be riding at the rear of the train or on the engine when the breakaway occurs.

7. Train resistance test; fifty car mixed trains, first to pass No. 1 stop post at 20 miles per hour, letting the train drift to a stop, no brakes being applied; second, to pass No. 3 post at 5 miles per hour, letting train drift until No. 4 post is passed, at which point the accelerated speed shall be recorded and the train stopped.

The following are the rules governing the tests.

RULES GOVERNING BRAKE TESTS TO BE HELD ON THE CHICAGO, BURLINGTON & QUINCY R. R., AT BURLINGTON, IOWA, COMMENCING MAY 9, 1887.

1. Each brake company will provide its own engine; such as do not wish to furnish a special crew will be furnished from working crews of Chicago, Burlington & Quincy R. R. Ordinary eight wheel, four wheels coupled engines must be employed; each engine must have 17 × 24 cylinders and not less than 51,000 lbs. on the drivers; both tender trucks must be provided with brakes and cast-iron shoes; plain wrought-iron shoes to be used on the drivers. Each brake company to have the option of using its own or such other engine brake as it can procure.

2. Each brake company will furnish, fitted with its brake, 50 box cars of 40,000 lbs. capacity or over, and 34 ft. long being preferred. Each car to be equipped with brakes on both trucks and plain cast-iron shoes. The cars to be delivered to the committee, free of charge, at some point on the Chicago, Burlington & Quincy Railroad on or before May 2. After the trial the cars will be returned to the owners at the points of delivery.

3. The Chicago, Burlington & Quincy Railroad will not be held responsible for mileage of cars while on its lines or for any damage to the cars that may occur through the inefficiency of the brakes.

4. Close couplings are recommended, and companies using link and pin couplers must be provided with wedges to take up slack. Half the stops will be made with close couplings and half with slack, should any of the brake companies so elect.

5. In operating brakes they must be applied and released by the engine man only, except as specially provided for in test No. 6 special tests.

6. Three runs over the course will be made with tests one, two and four. Two runs will be made with test number six, and one run with tests numbers three, five and seven.

7. Sand must not be used on any of the stops except with the special permission of the committee.

8. The leverage of the brakes will be recorded by the committee, and none of the apparatus must be changed at any time during the trials, except as previously provided.

9. With continuous brakes the pressures carried on the engine prior to the application of the brakes will be recorded for each test.

10. All tests to be made under like conditions of rail, grade, etc., as near as possible.

11. A dynamometer car will be placed in the front end of each train with complete recording mechanism. In the middle box-car of each train a portable apparatus will be placed for recording diagrams, showing, first, a strain line in pounds exerted on the brake lever during the stops, and, second, a speed line in miles per hour during each stop. An electrical signal will be arranged for communication between the front and rear ends of the train.

12. Competitors will be subjected to all the general tests; special tests will be optional.

13. The rapidity with which the train gets away after a stop will be noted, the time being taken from stop to start. In case breakages or causes foreign to the brake interfere with getting away, the record will be thrown out.

14. The parts pertaining to each brake, other than the foundation brake, hose and diaphragms, will be painted a red lead color.

15. Each brake company will use its appliances in the manner it shall consider best, provided that in the opinion of the committee such methods are safe and practicable in ordinary working.

16. The committee reserves the privilege of adding such tests as in its judgment may be deemed desirable.

17. Three or more competitors will be required before the tests will be entered into. Any competitor desiring to enter the tests should communicate with the chairman on or before April 1.

18. The committee are not in a position to furnish equipment for these tests, but regard the subject of great interest to rail roads and trust they will contribute to its success by furnishing engines and cars to the competing brake companies and affording them any other reasonable facilities.

The New Works of the Rochester Car Wheel Company.

The new works of the Rochester Car Wheel Co. at East Rochester are in operation, and are conveniently situated on a tract of 13 acres adjoining the New York Central. The new works were designed by Mr. C. S. Ellis, architect, Messrs. Ellsworth & Grant being the contractors.

The main or foundry building is 243 ft. long and 80 ft. in width. It is well lighted and ventilated, and experienced foundrymen are greatly pleased with its design. Directly through the middle, running lengthwise, is an iron walk, on either side of which are located the molding floors, each with a crane in the center. The capacity of each is 21 wheels, and as there are eleven floors, 225 wheels can be turned out daily. The cupola room is south of the central portion of the foundry, and the molten metal is wheeled to the various floors, and by means of the cranes turned into the molds. There are two cupolas, but only one will be used as a general thing, it having a capacity of from 60 to 65 tons per day. The cupola elevator was made by L. S. Greaves, of Rochester.

Power is furnished by a 100 horse-power Root boiler, which supplies steam to an 80 horse-power Green-Corliss engine, made by the Providence Steam Engine Co. Conveniently near the engine rooms is another building for coal, coke and sand, on the upper floor of which is the pattern department.

The entire length of the company's tract, a distance of 1,800 feet, is traversed by two railroad tracks running directly to the shipping room. The cost of the buildings and improvements, exclusive of the purchase price of the land, will exceed $50,000. The office is located in a separate building, just east of the foundry, and is finished in oak, the work having been executed by the Hayden Furniture Company. The buildings are heated by steam, the contractors for this portion of the work being Howe & Bassett.

The capital stock of the company is $100,000, all paid in. The officers are: President, Hon. William K. Barnum, of Connecticut; Vice-President, William H. Chapin; Secretary and Treasurer, Charles T. Chapin; General Foreman, Edward J. Campbell.

The yearly capacity of the new works is 18,000 tons of iron, which will make up into 60,000 wheels. When running at full capacity from 60 to 70 men will be employed,

Beauty in Machine Design.

Of late years there have been great improvements in the designing of railroad machinery, but in many quarters there is still a possibility of making forms of a shape that would be more pleasing to the eye without detracting in the least from utility. There has been an erroneous impression that an article which is of beautiful shape must necessarily be defective in strength or inferior in some other respect. To those who entertain such views we would recommend the perusal of the article on Beauty in Porter's "Mechanics and Faith." Respecting the combination of fitness and beauty, he says:

"It is not necessary that we should have the intellectual apprehension of the fitness of anything for its use, in order that we shall feel the sense of harmony and regard the object as beautiful. But if in any case we do have this perception of fitness, then this perception must be satisfied or else the object cannot appear beautiful.

"This is a test that, of course, we are able to apply only in cases of known unfitness of an object for its use. Such cases can not be found in nature. For examples of such want of fitness we must look to the works of men. There, indeed, unfitness in some respect or degree of a construction for its use constitutes the rule rather than the exception, and offends the mind that has been educated to perceive the unfitness. Architecture would afford many illustrations in point.

"Machinery, where, as in the case of architecture, man is himself the creator, affords admirable illustrations of the same truth. Here we are able to see with peculiar distinctness the necessity for harmony if any thing is to appear beautiful to us. The illustrations of these truths that may be drawn from machinery possess an especial force and value, because here all uses lie within our comprehension, and the fitness of every part of any machine, and of the machine as a whole, for its use, can be determined in a more unmistakable manner. Every machine has its special use. This use was proposed by its constructor, and he has made all the adaptations of the several parts and of the whole of the mechanism to its accomplishment, and the degree of success or failure is a matter of certain observation. To the instructed mechanical engineer no mechanical forms or proportions can appear beautiful unless a good mechanical reason can be given for them. Those forms and proportions are always the most graceful and elegant that most completely fulfill mechanical requirements. We are able to see at once that the pleasure that the builder of a machine can derive from the contemplation of his work, all the beauty that it can possess in his eyes, depends wholly upon his perception of its fitness, or of what he believes to be its fitness, for the use for which it was designed. The same is true also of any observer who has a knowledge of such uses.

"Now, with respect to this fitness, we are in reality always in a greater or less degree mistaken. Nothing perfectly fitted for its use was ever made by man. Still, especially in our own work, we can not see all the imperfections. All will admit, however, that in machine construction perfection is an ideal that men may always be striving after, but can never reach. We may, however, observe that first in the degree that we imagine ourselves to have attained a high point of excellence in any mechanical construction, just in that degree will its form appear beautiful to us. I was once asked by a steam engine builder as he contemplated his own work with an expression of absolute satisfaction and delight, 'why is that not a perfect engine?' My views were so different that I was quite shocked by the question. Such satisfaction designers always feel so long as they do not know any better. But when afterwards from enlarged knowledge, probably obtained by the agreeable process known as experience, we have come to see that our work is in fact, in some degree or respect unsuitable for its purpose, all becomes changed.

"In the earlier days of machine construction, before this construction became a science through the study of its underlying principles, it was the custom to employ architectural forms, these being the forms with which designers of machines were already acquainted, and very beautiful these adaptations of classic and Gothic features were thought to be. As, however, the unfitness of these forms to resist and transmit mechanical stress, and to perform the various functions which are demanded came to be perceived, and the necessity for entirely new forms designed to meet a new class of requirements, and for freedom in such new designs, untrammeled by the attempt to retain old forms in any degree, came to be realized, how rapidly and how utterly did all the once fancied beauty of these forms in such construction disappear."

Promotion of Mr. R. H. Soule.

Mr. R. H. Soule, who has been superintendent of motive power of the New York, Lake Erie & Western Railroad since December, 1885, has been promoted to the position of general manager of that road. The rolling stock of the road had fallen into such a deplorably bad condition before Mr. Soule took charge that it was a by-word among other roads, a burden to all who were responsible for keeping it running and a terror to interchanging connections. Mr. Soule went to work energetically to effect radical remedies, and very decided improvements were soon effected by his vigorous clear-headed management and ability as a designer. It seemed that portions of his department had become feeble through the burden of years, other portions were partly paralyzed through conflicting control, and powerful vested interests were at work operating for the benefit of employés rather than in the interests of the company. Mr. Soule grappled the hydra-headed abuses of his department, fought them and came out conqueror. Only those familiar with the internal working of the Erie as long as the memory of man goes can realize the herculean task performed by Mr. Soule in putting the operation of his department upon a strictly business basis. His successful management of the mechanical department no doubt recommended him as the right man for the higher position, for there still remain Augean stables to be cleaned. Mr. Soule is still a young man, having been born at Boston in 1849. He is a graduate of Harvard University, and entered railroad work in 1875 as a draftsman in the mechanical engineer's office of the Pennsylvania Railroad, at Altoona. Four years afterward he was promoted to be superintendent of motive power of the Northern Central. On the death of Howard Fry in 1883, he was appointed superintendent of motive power of the New York, Lake Shore & Buffalo, from whence he went to the Erie.

Driver Brake for Consolidation Engines.

The American Brake Company, of St. Louis, have got their driver brake attachments for the consolidation engine very finely developed. The shoes apply only to the forward part of the driving wheel, and the connections are so well arranged that an equal pressure is put upon each wheel. They say the object of their invention as now used is to apply an equal braking pressure to all the wheels, and also to thoroughly compensate for all unequal wear of the brake-shoes or tires. The equalization is accomplished by means of floating levers actuating the brake-heads, the arms of which are so proportioned relatively to each other, and to the successive levers of the series as to accomplish that result. If the brake is to be applied to any less number of driving wheels, the floating levers are consecutively omitted, commencing with the first of the series, or that nearest the source of power. To facilitate adjustment, a thoroughly practicable slack adjuster is employed. The brake is susceptible of application to all the drivers, no matter how closely they are connected.

Coroner's Verdict on the Republic Accident.

The investigation of the accident on the Baltimore & Ohio Railroad, at Republic, O., has been very protracted, but the verdict is now published. The coroner finds that the persons killed came to their death through gross negligence on the part of the officials and managers of the Chicago division of the road, and through the gross negligence of Conductor L. F. Fletcher in failing to signal the express train, and through gross negligence on the part of the owners, managers and officials of the Baltimore & Ohio Railway Company for using on said express train inferior and ineffective brakes, also for using an improper, dangerous and unlawful method of lighting and heating the cars of said express. He says it would seem that such negligence as resulted in such a great loss of life could not be other than criminal, but there are no laws in Ohio making such negligence a crime, and no laws under which such persons can be charged with crime. The verdict will cause something of a stir, and will probably be the cause of the enactment of laws making such negligence as described a crime, with severe punishment.

Testing a Car Heater.

A Smith & Owen car heater was subjected to a novel test a few days ago at the Grand Central Station in New York. A description of the construction of the heater will be found in the proceedings of the New England Railroad Club on another page. The object of the test was to show its capacity to resist breakage and extinguish the fire in case breakage should occur. For this purpose a roaring hot fire was made in the stove, and it was then hoisted to the top of one of the bridges crossing the track yard, a height of some fifty feet from the pavement below, where a quantity of inflammable materials was placed in such a position that they would take fire in case the stove was broken. The fall, however, had no other effect than to make a large dent in the top of the stove. As it rebounded from the pavement and rolled into the straw and wood, a cloud of steam was let loose and the fire went out without igniting even a splinter. The test was witnessed by a large number of railroad men and others, who were very favorably impressed in regard to the strength and safety of the device as a means of heating passenger cars.

The Central Railroad Club.

This club was organized at Buffalo, Jan. 26, by a meeting of railroad men representing the New York Central, Erie, Lake Shore, Michigan Central, Chicago & Rock Island, C., C., C. & I., Boston & Albany, and other contiguous roads that have heretofore been represented at the informal meetings that have been held from time to time at the Tifft House in Buffalo. A constitution was adopted and the following officers elected: President, R. H. Soule, Buffalo; Vice-President, T. Sullivan, St. Thomas, Ont.; Secretary and Treasurer, E. Chamberlain, Buffalo; Executive and Financial Committee, R. H. Soule, Chairman, E. Chamberlain, W. F. Turreff, F. B. Griffith, John Kirby, R. C. Blackall.

The headquarters of the new club will be in Buffalo. Its territory will include more especially the roads terminating at Buffalo, Cleveland, Detroit and Toledo, but railroad men from any part of the country, if engaged in constructive and operative work, are eligible to membership. Its purpose is to promote knowledge concerning the operation, repair and construction of railroad appliances and service in general, and the cultivation of sociability among its members. Meetings are to be held on the fourth Wednesday in March, May, July and October.

NATIONAL CAR AND LOCOMOTIVE BUILDER

PUBLISHED MONTHLY

BY

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *The editorial department will contain our own views and opinions; and the rest of the reading matter, aside from advertisements, will be such as we consider of interest to our readers.*

Contributions.—*Articles relating to railway rolling stock, construction and management, and kindred topics, by those who are practically acquainted with these subjects, are especially desired. Also early notices of changes in railroad officers, organizations and names of companies.*

Special Notice.—*As the* CAR AND LOCOMOTIVE BUILDER *is printed and ready for mailing on the last day of the month, advertisements, correspondence, etc., intended for insertion, must be received not later than the 25th day of each month.*

Double and Single Nozzles.

We have received letters from several master mechanics informing us that the article we published in the January number of the NATIONAL CAR AND LOCOMOTIVE BUILDER, describing experiments with various forms of exhaust nozzles, had induced them to try the single exhaust nozzle. Observations in various parts of the country have also convinced us that the change in the form of exhaust pipe in locomotives which necessarily followed the almost general adoption of the extension smoke-box, is leading to a great many experiments that are undertaken for the purpose of determining the form and position of exhaust nozzle that will produce the most economical results in service. In working out this practical problem our master mechanics might be spared considerable expense and no end of fruitless labor by careful study of what has formerly been discovered by others work...

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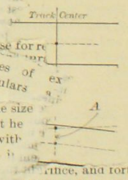

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stance in easi... ...ance, and fortunately these are just the most acc...modating elements; for whatever proportions may be imposed upon the boiler in compliance with certain conditions of stability, weight or arrangement, there can be nothing to interfere with the adoption of the most efficient blast pipe and chimney." He found that the proper diameter of the chimney depended on the grate area and flue section of the boiler, and that the best position for the exhaust opening was a distance equal to the diameter of the stack below the stack opening. Where this position was deviated from, reduction of exhaust opening had to be resorted to as a means of maintaining the required draft.

It might be supposed that Mr. Clark's conclusions may not entirely apply to modern sizes and to American designs; but the results obtained by later experimenters working with American locomotives, indicate that the proportions and adjustments which were found most satisfactory in 1847 with small sizes, are likely to produce similar effects in 1887 with enlarged sizes. Eight years ago, Mr. John E. Martin submitted to the Master Mechanics' Association an elaborate report of very exhaustive and carefully conducted experiments carried out with American locomotives on a railway in Chili, their purpose being to determine the most economical form of draft appliances. Fuel being very expensive in the region, any arrangement likely to reduce the consumption of coal was deemed highly important, and led to the experiments being carried out with unusual thoroughness. He found that a single nozzle which he calls "compound," set with the opening two or three inches above the upper row of flues,

gave the greatest satisfaction. Blast pipes ending in a single orifice, and having the openings of each pipe at the junction of about the same size as the top opening, are used by several roads, and they embody the peculiarities of Martin's compound nozzle.

As the conclusions formed from his experiments, Mr. Martin reported: "The single nozzle has a much milder effect upon the fire (than double nozzles), especially when pulling on heavy grades and in heavy switching. The draft seems to be more constant, the air passing through the bars in a steady stream, and not with a succession of blasts as in the double form. The coal on the bars is less agitated with the single nozzle and much less fire is thrown from the stack. The vacuum in the smoke box is more constant, as shown by the oscillation of the water in the vacuum gauge. In the double nozzle the steam is not discharged directly under or concentric with the smoke-stack, but on the side of it. This discharge is not so effectual as that of the single form, which is directly under and concentric with the chimney. In this we have the secret of the larger size of single nozzle. The steam from the single nozzle fills the stack like a plunger, effectually driving out all the smoke or gases. The gases from all parts of the smoke-box rush with equal force to fill the higher vacuum formed in the stack, and the steam plunger working in quick succession maintains constant this equal flow of the gases."

Annual Report of the Master Mechanics' Association.

We have received from Mr. J. H. Setchel the report of proceedings of the nineteenth annual convention of the American Railway Master Mechanics' Association, held at Boston last June. Our condensed report of the proceedings published after the meeting, made our readers familiar with what was said and done at the convention, but we can still recommend the full report as a valuable and interesting addition to the literature of practical engineering. For general interest to railroad mechanical men the last report will, we think, compare fairly with any that has preceded it. The president's address is undoubtedly the best and most appropriate inaugural address ever delivered at a master mechanics' convention. The reports and discussions cover a wide field of railroad engineering practice, and many valuable facts were elicited in both reports and discussions. The report indicates that the one hour daily devoted to the discussion of short questions was particularly well utilized. Dumping Ash-Pans were shaken up; the Throttling of the Locomotive was opened wide; Form of Exhaust Nozzles was vigorously combat[e]d; Check Valves were laid bare; Steel for Driving Axles was hammered by conflicting views; and Fitting Truck Brasses received critical attention. The words said on all these subjects appear to have fallen on fertile ground. The pre-... on Locomotive Boiler Con-

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The following is an exhaustive out... Cleaning and livered by Mr. Angus Sinclair, under t... ...tive Drivers, B., C. R. & N. Mutual Improvement Cla... ...earch of in-

The object of the steam engine is to tr... ...amine the ergy of coal into mechanical work. The be... ...at deal of and consequently the best locomotive is tha... ...nteresting the greatest amount of work with the least... ...rovement tity of fuel and the ... locomotive ... Boiler Construction, and by Mr. John E. tend with ... Steam Engineering. The paper on Improve-marine eng... Boilers is very finely illustrated by tive compares very ... popular use. But at best the locomotiv... ...alves is also well defective machine. It only uses ab... but the report the energy of the coal consumed. Th... s respect. On comparison to waste being so very s... got out with ...made to produce a more effici... unusual care, and Mr. ... ...t for his work.

Inevitable and Preventable Heat Losses.

One of the first discoveries usually made by students of steam engineering is the fact that as a means of transforming the latent energy of coal into mechanical work the steam engine is an extremely wasteful machine. Scientists have found that a pound of good coal represents about eleven millions of foot-pounds of energy. Very few steam engines develop one million of foot-pounds of work for each pound of coal used in the furnace, and engines utilizing 10 per cent. of the coal are considered thoroughly first-class. This percentage of waste appears enormous, and the novice readily concludes that mismanagement must be responsible for a great portion of the wasted power. But increase of knowledge brings a realizing sense of the tremendous difficulties that obstruct the way of radically increasing the efficiency of the steam engine.

There have been a great many prime motors invented for the purpose of converting the latent energy of carbon into mechanical work, and several of them have been capable of utilizing a greater proportion than the steam engine of the heat energy employed; but none have been so reliable for every day work, and, with all its shortcomings and defects, the steam engine continues to be popular with all power users who find it important that their machinery be kept running day by day without interruption. In popular addresses we are continually hearing the prediction reiterated that science will yet lead the way in effecting radical improvements upon the steam engine. The past achievements of science in this direction have been exceedingly slender, and do not make the promises for future deeds very encouraging. The practical men, on the other hand, whose labors have done most towards developing and perfecting the steam engine, and whose opinions regarding future progress are entitled to the highest consideration, believe that its limit of possible economy has been nearly reached.

Although a steam engine that converts 10 per cent. of the potential energy of fuel into mechanical work may be regarded as a wasteful machine, it is not wasteful when compared with the great mass of engines running our railroad trains and our mills, for very few of these utilize more than 5 per cent. of the heat stored in the coal used. The opportunity for railroad engine improvers at the present day appears to be in carrying out methods which will bring up the performance of the common five per cent. engine towards the high-class engine that takes ten per cent. dividend out of the coal. The men who busy themselves with this problem may safely leave to others the work of improving what is now regarded as the high-class engine. The great avenue of waste with all steam engines is the exhaust steam, and there is no probability that the loss of heat passing out by this channel will ever be radically decreased while steam is employed as a mode of motion. There are, however, lines of economy that may be worked on to advantage by our master mechanics and locomotive designers. Numerous minor causes of waste could be closed up by intelligent management, and the resulting saving would materially increase the economy of the engine. Even the most defective locomotive boilers in use are more efficient in giving back equivalents for the heat received than the best proportioned and best protected cylinders, yet it is easier effecting improvements on the boiler than on the cylinders. A good locomotive boiler accounts for over 50 per cent. of the heat liberated from the coal; few cylinders convert 10 per cent. of the heat of the steam entering them into mechanical work. Still, with all its relative efficiency, there is much preventable waste going on in boilers owing to faults of construction and careless or unskillful management. There is loss from bad proportion of grate surface and flue area, from the gases of combustion being improperly mixed, from defective means of admitting and restraining air supply, from the gases being passed over the heating surfaces too rapidly, from water being passed through the dry pipe along with the steam, and from radiation of heat due to defective covering. The preventable losses in the cylinders are due to too limited expansion caused in various ways, to back pressure caused by faults of design and restricted exhaust opening, to attenuated steam line at short cut-off, and excessive compression resulting also from faulty design of the valve motion, and to condensation caused by imperfect covering.

Pointing out errors of design and causes of waste is, we admit, much easier than the work of effecting remedies. Wasteful practices and carelessness about details are apt to creep into the best conducted departments unless persistently checked by the responsible officers. The vigilance and labor that produce the checks must be ever awake, ever active, and when this is the case their effects are very apparent on the operating expenses.

For and Against Extension Smoke-Boxes.

In his vigorous and pointed letter on Extension Smoke-Boxes published in another column, Mr. J. Snowden Bell, who is an expert in matters pertaining to draft appliances, calls on the friends and advocates of the extension smoke-box to give their reasons for believing why 36 to 44 inches extra length in a smoke-box attains the remarkable results ascribed to it. The opening of the letters leads us to think that Mr. Bell expects that we will enter the lists as advocates or defenders of the extension smoke-box, but we have no disposition to do anything of the kind. We believe that the numerous extension smoke-boxes in use are giving much better results in spark arresting than the old diamond stack, and we are under the impression that in most instances the combination of open stack, high single nozzle and deflecting plate that accompany the extension point, enable steam to be made with a softer exhaust than could be used successfully with the diamond stack, and that consequently economy of fuel results; but we are far from attributing any saving to the greater cubic content of the smoke-box. In fact we are faithful believers in Clark's principle, which held that the cubic content of the smoke-box must be proportioned in relation to the area of grate. His rule, which we believe is still considered good engineering gospel, calls for three cubic feet in the smoke-box for one square foot of grate. This proportion would require the smoke-box of the Old Colony locomotive illustrated in this issue, to be 33 inches long and its length is just double that.

Some master mechanics, who ought to be well able to judge the value of improvements on the locomotive, and who have investigated the effects produced by the extension front, reported that it acted on the exhaust in the same way as an air chamber acts on the stroke of a pump plunger—it softened the jerk of the exhaust on the fire. It is possible that other circumstances than the increased size of smoke-box might have caused the softened action of the blast, but the large box gets any credit there is attached to the change. Our impression is that the claims of superior fuel economy claimed for the extension *per se*, are not well founded.

If locomotives were so constructed that all the fuel was retained in the fire-box, we readily admit that there would be no need for spark arresters. But our experience does not permit us to agree with Mr. Bell when he says, "it is possible that there may be engines of antiquated construction whose fire-boxes are so inadequate to the service that a large proportion of their fuel is lifted from the fire by the exhaust and drawn through the tubes, but it can scarcely be maintained that in present practice combustion is so defective as to need or even justify a receptacle for unconsumed fuel of the dimensions of an ordinary extended smoke-box." That is precisely what we are prepared to maintain and even to go a little beyond. From the observations made in daily journeys around the greatest railroad center in the world, we have come to the conclusion that the crying need of the day is a spark receptacle as big as a box car—at least the supply of sparks is liberal enough to demand a holder of that capacity, and many of the locomotives creating the need have been built within two years. And the mountains of sparks to be found outside the engine houses of most roads using the extension smoke-box will corroborate the truth of our statement. We hold that with locomotives of this character it is better to have the means of carrying the sparks to the end of a division, than to pitch them out upon the right of way to raise fires. While we think that the extension smoke-box is the best spark-arrester in use we are willing to concede that its presence on the engine ought not to be necessary. We have encountered wide diversity of opinion respecting this subject among the men most interested, and we would now be pleased to receive their views on the points raised by Mr. Bell.

WE would direct the attention of our readers to the most interesting sketch on another page, of the life of Joseph Whitworth, the great mechanical engineer, by Mr. John Fernie, of Philadelphia, whose vigorous and able defence of American railroad machinery in leading British journals is familiar to many of our readers. Every intelligent man who understands the value of accuracy and interchangeability in mechanical operations is certain to be interested in reading particulars of the inestimable services rendered to engineering science by Joseph Whitworth. When the story of this great engineer's work is told by a friend possessing the gift of expression that Mr. Fernie has in an eminent degree, its perusal is a source of keen enjoyment. The sketch throughout reads like some of the most interesting pages in Smiles' Lives of the Engineers. We heartily welcome Mr. Fernie to the pages of the NATIONAL CAR AND LOCOMOTIVE BUILDER, and hope that our readers may enjoy the benefit and pleasure of many more contributions from his pen.

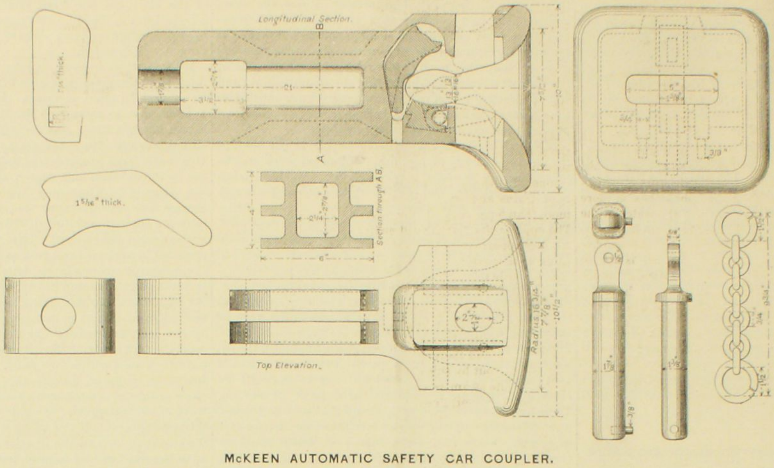
As will be seen from our account of the last meeting of the Master Car Builders' Committee on Freight Car Brakes, the committee have decided to delay the final tests for one month, and hold them at Burlington, Ia., beginning on May 9. This we believe is a very wise decision, for it is very desirable that good, or at least uniform, weather should prevail during the time the tests are proceeding, and the chances for even weather in Iowa earlier than May are very uncertain. It is likely that several new competitors will be present, and in that case the efficiency of all the brakes will be judged from what they do during these tests. To judge of the relative performance of the brakes nearly uniform atmospheric conditions are absolutely necessary.

THE next meeting of the New England Railroad Club will be held at the rooms, in Boston, on Wednesday evening, March 9. Subject for discussion, "Lighting and Ventilating Cars in Passenger Service."

A Valuable Business Atlas.

The revised edition of Rand, McNally & Co.'s Business Atlas for 1887 is the most complete and elaborate publication of its kind ever issued. It contains upward of a hundred large scale, tinted maps of the United States and the chief cities of this country; also Canada, Mexico, Central America, and the principal countries in other quarters of the globe. The maps are executed with an elaboration and distinctness of detail that must satisfy the most exacting. The additional railroad mileage of 1886 is represented. The volume also contains an index of some 200,000 cities and towns, with an admirably devised system of references showing population, location on maps, railroad stations, express companies, mailing points, money-order post-offices, etc. The price of the atlas has been reduced to $12.50, and each subscriber will receive, free of charge, a quarterly bulletin until October, 1888, containing supplemental changes in the geography of the United States to the end of every quarter.

THE Manchester Locomotive Works have received an order for 30 locomotives for the Atchison, Topeka & Santa Fe road, an order for nine locomotives from the Boston & Lowell road, and other orders from the Concord & Minneapolis and St. Louis railroads. These orders alone will keep the works busy, with increased help, until July.



McKEEN AUTOMATIC SAFETY CAR COUPLER.

The accompanying illustrations represent this coupler, which is used on the Lehigh Valley, the Long Island and other railroads.

The coupler is of the link and pin type, with pin supporter and link controller. The pin supporter is shown in detail on the left hand side of the engraving. In the longitudinal section of the coupler the solid lines show its position when pushed back by an entering link. When supporting the pin, the supporter falls forward by gravity and takes the position shown by the dotted lines.

The link controller, by which the link can be elevated or depressed in order to enter the high or low draw-head of another car, is also shown in both positions in the longitudinal section, and in detail in the upper left hand corner of the illustration. No ice, cinders or other substances can obstruct the working of the parts.

The pin supporter and the link controller are guarded from any possible injury by rough usage. Should the pin supporter receive a heavy blow, it is forced by the link up the inclined plane at the back, and the blow is thus cushioned without doing any injury.

The link controllers lie in a recess, and are thus shielded from any injury by an entering link. A rod runs across the end of the car, by means of which the pin is pulled, set not to couple, and the link controller is operated from either side of the car.

It will be readily seen that any form of draw-bar may be used in cast or malleable iron, and a new core box only is necessary to adapt this coupler to any pattern of common draw-bar in use.

The rod for pulling the pin and controlling the link can be put on any style of flat, box, coal, tank, gondola or other freight car and be entirely out of the way.

Continued use has thoroughly tested the effectiveness of this coupler.

Ajax Metal.

Mr. J. G. Hendrickson, of the Ajax Metal Company, of Philadelphia, writes us as follows:

"We have to day our Patent Adhesive Lead Coating for iron and other metals completed, the process being perfect and practical. We use a molten metal bath the same as used by galvanizers, but substituting lead for zinc, and the same apparatus in connection with our patent improvements. By the use of this process we can furnish railroads with sheet iron coated with pure lead for roofing; will last the life of any car, machine shop, or roundhouse, and will be as perfect when removed as when first put on. The coating is simply indestructible, either by acids, alkalies, etc., there being but one acid that destroys it, and that is nitric. The coating resists anything and everything else. The cost will not be any more than galvanized iron. We will be in position in a short time to fill orders. If we had a plant to-day, we could have all the work without soliciting, to keep at least three baths busy.

"We propose coating all metallic surfaces, such as wire, sheet metal, pipe, wrought iron and malleable iron fittings, in fact everything in the line that is exposed to the weather or acids."

Magnolia Anti-Friction Metal.

Mr. L. Pfingst, master car builder of the New York Third Avenue Surface Railway, writes to Mr. Charles B. Miller, manufacturer and proprietor of this metal, that he had taken out the two Magnolia bearings from car No. 85 of the road, and found them as sound as when put in, and the other two entirely gone. We learn that other and still more remarkable tests of the superiority of this metal for bearing purposes have recently been made, but are at present unable to give the details.

THE AMERICAN BRONZE WORKS, of Cleveland, Ohio, J. W. Heiser, proprietor, have more orders on hand for their Car and Locomotive Brasses than they ever had at one time before; they are working double turn and melting between three and four tons of metal per day, and can hardly keep up with their orders.

THE EGAN CO., of Cincinnati, O., writes us as follows: "During the night of Feb. 2 the extensive works of the Eagan Co., Cincinnati, O., the well-known manufacturers of wood-working machinery were partially destroyed by fire. About one-third of the establishment, including their pattern shop and planer room was burned. Fortunately, very few of their patterns were in the building, otherwise the loss, while it is severe, would have been much heavier. The company will not be interfered with to any great extent in the transaction of business; all orders will be promptly filled. The greatest loss is in the delay in getting the insurance adjusted. When this is accomplished, the burned portion will immediately be rebuilt. In the meantime temporary warerooms have been secured in an adjacent building, and a double force of pattern makers will be at once put to work.

The members of this company are all young and enterprising, and each put his shoulder to the wheel and worked energetically to get the vast establishment running to its full capacity. At this writing they are in good shape to handle any business their friends and customers may favor them with, and orders will be filled with usual promptness."

THE rapidly increasing business of the Damascus Bronze Co., of Pittsburgh, has made it necessary to increase their facilities for production; their old foundry not being large enough, they have erected at Alleghany one of the largest and most complete foundries of its kind; it is a very substantial building, being constructed of stone brick, and iron; the moulding room is well lighted and is 120 by 50 feet wide, and the furnace room is 60 by 50 feet wide. They have an open hearth Swindell furnace capable of melting three heats a day of 4,000 pounds of metal to the heat; they use natural gas for melting and discard the use of coke and crucibles; they have engaged the services of Mr. Thomas Harrington, a well known metal worker of large experience, formerly with the Colorado Silver Metal Co., of New York, as manager in the place of Mr. M. J. Graney, having purchased all of Mr. Graney's interests in the company, they now own all of the patents relating to the manufacture of the metal.

THE CINCINNATI CORRUGATING CO. sends us the following: "The State of Texas, which is about completing its new capitol, will cover it with copper, using about 800 squares. The Cincinnati Corrugating Co., of Cincinnati, Ohio, has the contract for this copper roof, which will be, perhaps, the largest amount on a single building in the United States. For buildings owned by the people, not by individuals, copper is far the cheapest roofing; for although more expensive in first cost it far exceeds all others in durability, and does not require painting, or other repairs, if applied properly."

THE PAGE BELTING CO., of Concord, N. H., have issued an illustrated and descriptive catalogue of leather and rubber belting, lace leather, etc., containing detailed information and price-lists of the various qualities and grades. The catalogue also contains a chapter of practical rules for the location of shafts and pulleys, and in reference to the purchase and use of belts, as well as a variety of other information pertaining to the products of the company's manufacture, and by which persons using belts may determine their adaptation to different kinds of work.

MESSRS. GOODELL & WATERS, of Philadelphia, have just issued a large illustrated single-sheet poster, ten square feet in size, and containing cuts of the various wood-working machines of their manufacture. The poster is intended for distribution among the mills and shops in which this class of tools is used, and will be appreciated by mill men and operators as a valuable reference sheet. A copy of the poster will be mailed to parties on application as above.

MR. W. P. SEGUINE, who has for the past fifteen years been connected with the firm of Gardner & Co., of New York, manufacturers of perforated veneer car seats and ceilings, has associated himself with Messrs. Frost & Paterson, 161 West Eighteenth street, New York, who are also engaged in the same line of manufacture, including panels, headlinings and other decorative work for railway cars.

OUR January issue contained a notice of a compound for the prevention of scale in locomotive boilers, which was being used with success by Mr. John Player, the master mechanic of the Central Iowa Railway. This compound is manufactured by the Pittsburgh Boiler Scale Resolvent Co., of Pittsburgh, Pa.

THE MISSISSIPPI GLASS CO., of St. Louis, Mo., have received an order from the Gilbert Car Mfg. Co. for 10,000 deck lights (understood to be for the Manhattan Elevated road) and a large order from the same company for the Missouri Pacific. The Mississippi Glass Co. is also selling its products to the Barney & Smith Co., the Laclede Car Co., and also to several railroads.

THE HANCOCK INSPIRATOR CO., of Boston, celebrated the manufacture of their one hundred thousandth machine by a dinner to their employés at the Quincy House in that city on Monday evening, Feb. 21.

WE have received a copy of the official report of the proceedings of the Master Car-Builders' Association at their annual convention at Niagara Falls last June, but too late for formal notice in our present issue.

THE PHOSPHOR-BRONZE SMELTING CO., of Philadelphia, have issued a new catalogue and price-list for 1887.

MR. F. W. CRAM, general manager New Brunswick Railway, writes us: During the past year the greater part of the New Brunswick Railway has been ballasted. Those portions of our rails which were still of iron have been relaid with steel rails. Four of our wooden bridges have been replaced by steel bridges on steel piers. A number of our wooden bridges have been renewed. A number of station buildings have been erected and improved. Considerable addition and improvements have been made in connection with the company's shops at McAdam Junction; 14 locomotives, 15 passenger and baggage cars, 200 box cars and 300 flat cars have been added to our equipment. Two locomotives, two passenger cars and a number of freight cars have been built and rebuilt at our shops.

Our Directory.

We note the following changes since our last issue. Our readers will do us a great favor by giving us prompt notice of any changes that may come to their knowledge or of any errors that may be noticed in our list:

Atlantic & Pacific.—Geo. L. Sands has been appointed Superintendent, vice T. R. Gabel, Acting Superintendent, resigned. Geo. Hackney has also been appointed Superintendent of Machinery and A. C. Armstrong Purchasing Agent. This road has been consolidated with the Atchison, Topeka & Santa Fe.

Central of Georgia.—Morris S. Belknap has been appointed General Superintendent, vice Wm. Rogers, who has been appointed Assistant to the President.

Cincinnati & Eastern.—The name of this road has been changed to "Ohio & Northwestern."

Jacksonville, Tampa & Key West.—J. H. Burnett, late of the Louisville & Nashville, has been appointed Master Mechanic.

Minnesota & Northwestern.—W. L. Hanson has been appointed Superintendent of the Chicago Division.

New York, New Haven & Hartford.—W. H. Stevenson has resigned as Superintendent of the New York Division, and Joseph Scofield has been appointed as his successor.

New York, Lake Erie & Western.—R. H. Soule, heretofore Superintendent of Motive Power and Machinery, has been promoted to the position of General Manager; John W. Cloud, late of the Pennsylvania R. R., has been appointed to succeed Mr. Soule; A. M. Tucker, Superintendent of the Western Division of the N. Y. P. & O., succeeds D. H. Blackham as Superintendent of the Susquehanna Division; G. W. Bartlett, Superintendent of the Rochester Division, succeeds Mr. Tucker, and W. H. Starr succeeds Mr. Bartlett. Ross Kells has been appointed Superintendent of Motive Power.

Providence & Worcester.—Charles Howard has been elected Superintendent in place of W. E. Chamberlain, resigned.

Employment.

WANTED.—By a first-class Ornamental Designer, a position as Assistant Mechanical and Architectural Draftsman. Would prefer a position in a railroad shop. Can furnish first-class references. Address "T-Square," office of the NATIONAL CAR AND LOCOMOTIVE BUILDER.